PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the right. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

[*Continued on page* 3 *of cover*

MATHEMATICS 51

513.468 : 539.218

1619. Density and packing in an aggregate of mixed spheres. HUDSON, D. R. *J. Appl. Phys.*, **20,** 154–62 (*Feb.*, 1949).—It is shown that in close packing of spheres, 2 types of interstice exist, bounded by 6 and by 4 convex spherical surfaces. These are termed "square" and "triangular." They are connected by a continuous labyrinth through which a ball not exceeding $(2/\sqrt{3}-1)r$ in radius can be threaded. In both cubic and hexagonal arrangements, their shape and size are identical, but their distribution differs. Radii R for n smaller balls, which can take up patterns with cubic symmetry within each square interstice, are calculated for values of n up to 27 and plotted. The expression $R/r = (\sqrt{2}-1)/n^{\frac{1}{3}}$ is used as a test for efficiency of packing. When R/r is plotted against the density increment attributable to this interstitial packing, a set of spires is obtained. At $n = 8$ and $n = 9$ (R/r being, respectively, 0·2289 and 0·2166) twin peaks of 13% and 12% appear, which are accentuated by first entry of a sphere into the triangular interstice at $R/r = 0{\cdot}22475$; this contributes another 3%. The peak of 16% at $n = 21$, $R/r = 0{\cdot}1782$, is also reinforced by first entry of 4 spheres in a body-centred tetrahedron at 0·1716, which gives an additional 6% density increment. Applications to bulk storage, ceramics, and interstitial compounds and solid solutions are considered. None of the special packs gives a density increment $(\partial\Delta_{\text{square}} + \partial\Delta_{\text{triangular}})/\Delta$ even approaching the 26% for fine spherical filler close packed in the interstices. A.

517.432 : 513.882

1620. Rayleigh–Ritz and Weinstein methods for approximation of eigenvalues. I. Operators in a Hilbert space. ARONSZAJN, N. *Proc. Nat. Acad. Sci., Wash.*, **34,** 474–80 (*Oct.*, 1948).—The Rayleigh–Ritz method for approximation of eigenvalues and a method due to A. Weinstein [*Mémorial des Sciences Math.*, **88** (1937)] are interpreted in a Hilbert space and the convergence is proved for symmetric completely continuous operators (no restriction to positive definite operators). It is shown that the two methods are complementary in character, the R.R. method giving lower bounds for positive and upper bounds for negative eigenvalues, while the W. method gives upper bounds of positive and lower bounds of negative eigenvalues. H. MO.

517.432 : 513.882

1621. The Rayleigh–Ritz and Weinstein methods for approximation of eigenvalues. II. Differential operators. ARONSZAJN, N. *Proc. Nat. Acad. Sci., Wash.*, **34,** 594–601 (*Dec.* 15, 1948).—Results of an earlier paper are applied to eigenvalue problems for linear ordinary or partial differential operators. The practical applications which the author has in mind are exemplified by the problem of the eigenvalues of a clamped plate. It is shown how the knowledge of the solution of one type of problem may be used to find that of another. The solution may be sought in one domain while it is known in a larger or smaller one. In other cases the solution may be desired for one type of boundary condition, while it is known for another. These and more generalized problems are discussed in terms of Hilbert space concepts and solution methods based on the Rayleigh–Ritz and Weinstein methods are indicated. H. MO.

517.432 : 517.949.1

1622. Difference and associated operators, with some applications. BICKLEY, W. G. *J. Math. Phys.*, **27,** 183–92 (*Oct.*, 1948).—A comprehensive and consistent scheme of difference and associated operators is presented. These comprise an operator representing division of successive equally spaced values of the function; the forward, central and backward difference and summation operators; an averaging operator; and the differential and integral operators. Relationships between these operators are derived, and their application to reproducing or developing formulae for numerical interpolation, differentiation and integration is demonstrated. A special operator $\theta = \frac{1}{2}wD$ (where w is the interval of tabulation and D the differential operator) is introduced for speedy and systematic derivation of such formulae. A. SCH.

517.51/.52

1623. The application of Mellin transforms to the summation of slowly convergent series. MACFARLANE, G. G. *Phil. Mag.*, **40,** 188–97 (*Feb.*, 1949).—A powerful method is described, especially useful for series of the form, $\sum_{n=0}^{\infty} f\{(n+a)^{\nu}\}$. Examples studied are $\sum \frac{\cos(ny)}{n^2}$ and $\sum \frac{(-)^n}{2n+1} J_1\{(2n+1)y\}$. A table of over 70 Mellin transforms is given in an appendix. L. S. G.

517.61

1624. On path methods. EMDE, F. *Arch. elekt. Übertragung*, **2,** 211–14 (*June–July*, 1948) *In German.*—The method of steepest descent is used to evaluate integrals of the form $\int \exp\{Q(t)\}dt$. Application is made to the Gamma function and certain cylinder functions, and the asymptotic expansions are given explicitly. L. S. G.

517.61

1625. On path methods with paths involving three branches. EMDE, F. *Arch. elekt. Übertragung*, **2,** 214–17 (*June–July*, 1948) *In German.*—An extension of previous work [Abstr. 1624 (1949)]. Asymptotic expansions of certain functions, including $H^{\frac{1}{3}}(p)$ and $J_p(p)$ are derived. L. S. G.

517.63

1626. Generalization of the notion of function and of differentiation. Theory of distributions. SCHWARTZ, L. *Ann. Télécommun.*, **3,** 135–40 (*April*, 1948) *In French.*—The notion of a function is generalized to that of a measure, and this is further generalized and a "distribution" is obtained. The theory allows certain operations in the Heaviside calculus to be rigorously justified. Application is made to Fourier and Laplace transforms. L. S. G.

517.912.2 : 518

1627. A modified method of iteration of the Picard type in the solution of differential equations. DJANG, G.-F. *J. Franklin Inst.*, **246**, 453–7 (*Dec.*, 1948).

517.933 : 534.014.5

The van der Pol oscillator. *See Abstr.* 1753

517.942.9

1628. Polyhedral harmonics. LAPORTE, O. *Z. Naturforsch.*, **3a**, 447–56 (*Aug.–Nov.*, 1948) *In English.*—The problems of finding solutions of the 3-dimensional Laplace-equation which either vanish or whose normal derivatives vanish upon planes meeting in one point are discussed. Solutions possessing the symmetry of the regular bodies, polyhedral harmonics, are given. Following Klein, polyhedral invariants are listed. Methods for obtaining polyhedral harmonics are illustrated for the octahedral case. A table of harmonics for the other cases is followed by a consideration of the nodal lines for a few octahedral harmonics, a theorem concerning the lowest odd harmonic and an indication of some unsolved problems. H. MO.

517.946.9 : 536.2 : 534.11

1629. Note on the use of almost periodic functions in the solution of certain boundary-value problems. ROETTINGER, I. *J. Math. Phys.*, **27**, 232–9 (*Oct.*, 1948).—Certain linear integral transforms are used to obtain solutions in closed form. The method is applied to a vibrating-string problem and to a problem in heat conduction. R. A. N.

517.947.44 : 534.1

1630. Considerations concerning nodal surfaces arising in vibration problems. HERZFELD, K. F. *Z. Naturforsch.*, **3a**, 457–60 (*Aug.–Nov.*, 1948) *In German.*—It is shown that nodal surfaces must either be closed, or end at a boundary, or else at infinity. When the boundary is continuously deformed the number of nodal surfaces may change. H. MO.

517.947.44 : 534.01

1631. On oscillators with stabilized amplitude. HAAG, J. *C.R. Acad. Sci., Paris*, **226**, 1567–8 (*May* 19, 1948) *In French.*—See Abstr. 2652 (1948). The problem discussed is that of a simple oscillator, of amplitude α, and pulsatance ω, subjected to a disturbing force which operates under certain stated conditions. The motion of the oscillator tends asymptotically to a sinusoidal motion of amplitude α and pulsatance ω. The system is considered in its bearing on chronometry. G. G.

517.948 : 517.941.91

1632. Integral equations for the periodic solutions of the equation $u'' + (a_0 + a_1 \cos 2x + a_0 \cos 4x)u = 0$. LEBEDEV, N. N. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 1), 25–8 (1948) *In Russian.*—It is shown that the problem may be regarded and treated as a natural generalization of the standard integral equations of the Mathieu functions, or the latter as the limiting form of the integral equations derived in the present paper. B. F. K.

518.2 : 538.566

1633. Five-figure table of the function $\int_0^\infty e^{-zy} A_i^2(y - j_1)dy$ in the complex plane. HAY, H. G. *Phil. Mag.*, **39**, 928–46 (*Dec.*, 1948).—The tables give the real and imaginary parts of the function and its derivative to 5 figures, over the region $x = 0{\cdot}0(0{\cdot}2)4{\cdot}0$, $y = 0{\cdot}0(0{\cdot}2)3{\cdot}2$. They are useful in the problem of determining the eigenvalues of the wave equations for cm-wave propagation in the atmosphere. [See Abstr. 1956 (1948)]. L. S. G.

518.5 : 548.735.4

Calculating machine for X-ray structure factors. *See Abstr.* 2212

518.5 : 621.317.39

1634. An electrical instrument for solving second-degree algebraic equations. CURTIS, G. C. *J. Sci. Instrum. Phys. Ind.*, **25**, 341–3 (*Oct.*, 1948).—A method of obtaining quadratic variations in resistance from ordinary variable resistors (e.g. of decade-dial type) is described, and it is shown how this may be applied to the construction of an electrical calculating bridge for solving 2nd-degree algebraic equations. An instrument, designed on this principle for reduction of data in 3-dimensional sound-ranging, is briefly described, and some indication is given of the sphere of usefulness and the probable accuracy of such instruments. A.

519.24/.29

1635. Automatic computation of the standard deviation. GERMANS, F. H. Letter in *Nature, Lond.*, **163**, 25–6 (*Jan.* 1, 1949).

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.038 : 530.1

Gyromagnetic ratio for astronomical bodies and elementary particles. *See Abstr.* 1675

521.042 : 539.17

On Goldschmidts abundance distribution of elements. *See Abstr.* 2101

521.112.1

1636. On the relationships between the frequency functions of stellar velocities. DE JONGE, J. H. K. *Proc. Nat. Acad. Sci., Wash.*, **34**, 553–61 (*Dec.* 15, 1948).—Frequency distribution functions of linear space velocity and the tangential velocity are expressed in terms of the average distribution function $g(\rho)$ of the magnitudes ρ of radial velocities, the average being taken over the whole sky. It is assumed that the space-velocity function is invariant throughout the volume occupied by the stars considered, but no assumptions are made of its analytical form. [See also Abstr. 1538 (1936)]. R. A. N.

521.13 : 523.85

1637. Dynamical friction. WHITE, M. L. *Astrophys. J.*, **109**, 159–63 (*Jan.*, 1949).—The coefficient of dynamical friction is reconsidered, taking into account a "correction term" which arises principally from those field stars which travel with velocities > the velocity of the particular star. A table of this correction term is provided. The new values for the coefficient are used to redetermine the ½-lives for

galactic clusters; a value slightly < that obtained previously is found. A.

521.13 : 531.3

1638. The distribution of Jacobi constants in three dimensions. ROTH, H. *Acta Phys. Austriaca*, **2** (*No.* 1) 23–56 (1948) *In German.*—The restricted 3-body problem in the plane is discussed and Jacobi's integral of the equations of motion is derived. Hill's limiting curves are also discussed. A similar analysis is made in 3 dimensions, and Hill's limiting spaces are classified. The space distribution of Jacobi constants is represented by a series of graphs. L. S. G.

521.133

1639. Periodic solutions of the first kind in the three-body problem. CHAZY, J. *Bull. Astr., Paris*, **14** (*No.* 2) 153–75 (1949) *In French.*—The bodies are assumed to move in a plane, and the masses of two of them are taken to be ≪ the mass of the third. Solutions are made to depend upon a single arbitrary parameter. R. A. N.

521.134 : 531.353

1640. Stability of periodic solutions in the problem of two fixed centres. SÉMIROT, P. *Bull. Astr., Paris*, **14** (*No.* 1) 37–60 (1949) *In French.*—Various states of motion are considered, and all are found to be unstable with respect to arbitrary displacements. R. A. N.

522.24 : 535.43

Diffusion produced by balsam in special astronomical objectives. *See Abstr.* 1846

522.614.3 : 523.874

1641. A new projection instrument for the rapid determination of stellar radial velocities. PETRIE, R. M. AND GIRLING, S. S. *J. Roy. Astr. Soc. Can.*, **42**, 226–32 (*Sept.–Oct.*, 1948).—A projection comparator is described which reduces the time of measurement of a stellar spectrogram for radial velocity by projecting an image of the spectrogram on to a ruled zero-velocity comparison spectrum. A. HU.

522.615 : 535.33.07–15

1642. A solar infrared reflecting spectrometer. MCMATH, R. R. AND MOHLER, O. C. *Sky and Telescope*, **7**, 143–4, 158 (*April*, 1948).—Describes the optical and recording system devised to produce a highly dispersed solar spectrum. Besides visual examination, photoelectric recording using a PbS cell is provided. It is hoped to complete a list of solar lines to 25 000 Å. E. G. M.

522.98 : 519.271

1643. Correlated observational errors. ARBEY, L. *Bull. Astr., Paris*, **14** (*No.* 1) 75–87; (*No.* 2) 89–144 (1949) *In French.*—Mathematical treatment of correlations pointed out by Pearson on the basis of the general theories of Gauss and Laplace, extended by the author and illustrated by application to series of photometrical observations. A. B.

522.983.13 : 523.842.3

1644. Spurious periods in spectroscopic binaries. TANNER, R. W. *J. Roy. Astr. Soc. Can.*, **42**, 177–88 (*July–Aug.*, 1948).—It is shown that if the true period of a spectroscopic binary is used in plotting phase residuals $\Delta\phi$ against hour angle α, the observed points will lie along the α-axis. If a plausible but erroneous period is used, the plotted points will tend to lie along the lines $\Delta\phi = \pm\alpha, \pm 2\alpha, \ldots$ The method is applied to 149 published velocity curves: 5 have spurious periods and 19 more are doubtful. A. HU.

523.11

1645. Stellar evolution and the expanding universe. HOYLE, F. *Nature, Lond.*, **163**, 196–8 (*Feb.* 5, 1949).—Relativistic theories are examined in terms of current estimates of stellar ages and constitutions, the density of internebular matter and the clustering tendency among nebulae. Theories requiring the general background density of matter to have been much greater in the past are rejected as this would lead to the formation of nebular condensations of density ≫ that observed. It is suggested that this difficulty might be avoided by assuming a continuous creation of matter. Data from red-shifts gives a creation rate of 10^{-43} gm.cm^{-3} sec^{-1}, leading to a background density 5×10^{-28} gm.cm^{-3}. R. A. N.

523.161 : 523.87

1646. On the density distribution and chemical composition of the interstellar gas. STRÖMGREN, B. *Astrophys. J.*, **108**, 242–75 (*Sept.*, 1948).—Information on the density distribution and chemical composition of interstellar gases is obtained from observations of interstellar absorption and emission line intensities. The results are used to derive estimates of gas density within, and between, interstellar clouds of normal, and abnormal, electron densities. D. R. B.

523.161 : 523.87

1647. The distribution of interstellar sodium. SPITZER, L., JR. *Astrophys. J.*, **108**, 276–309 (*Sept.*, 1948).—Analyses of equivalent widths of interstellar *D* lines in stellar spectra with corresponding colour excess indicate that interstellar clouds of 5–10 parsec radius are responsible for strong *D* absorption in reddened stars having colour excesses ⩾ 0·10. The average computed density of neutral Na within, and between, such clouds is $\sim 5\times10^{-9}$ atom/cm^3, but inside individual clouds may rise to ten times this value. D. R. B.

523.2

1648. On a problem in rational mechanics concerning the formation of planets. SCHATZMAN, E. *Bull. Astr., Paris*, **14** (*No.* 1) 69–74 (1949) *In French.*—Weizsacker's theory [see Abstr. 1776 (1946)] suggests an idealized process in which planets are formed between 2 || streams of particles moving in opposite directions. Estimated periods of axial rotation agree well with observation for Jupiter, Saturn and Uranus, but are rather low for other planets. R. A. N.

523.44

1649. On the albedo of planets and the photometric determination of the diameters of asteroids. STUMPFF, K. *Astr. Nachr.*, **276**, 118–26 (*June*, 1948) *In German.*—The spherical albedo of Bond and Russell is the product of two factors: p, the geometrical albedo, and q, which depends on the variation of brightness with the phase. The author shows that where the latter is fully known it is not necessary to know the equation of reflection at the planet's surface. This is impracticable where the phase effect is limited as with any outer planet, and for such cases empirical relations between q and the observable phase coeffi-

cient are discussed. A theoretical basis is given for such a relationship. In the case of the asteroids, however, p also cannot be determined directly as the diameter is known only for the four largest, and enters into p. The author develops a statistical relation between p and the phase coefficient, suggested by L. Bell, which he is able to correct by Stebbins's phase coefficients for the four great satellites of Jupiter; the results are more consistent, and depart considerably from those obtained by L. Bell. The author is finally able to deduce diameters and albedoes for 25 asteroids, including the four largest, which reasonably agree with direct observation. T. L. MACD.

523.72

1650. The generation of radio-frequency radiation in the sun. RYLE, M. *Proc. Roy. Soc. A*, **195** (*No.* 1040) 82–97 (1948).—Solar noise, both from the quiet sun and from the disturbed sun, is considered to arise from the acceleration of electrons in the solar atmosphere. By the action of the permanent magnetic field of the sun and the non-uniform rotation of the surface matter, a high potential difference is developed between the poles and the equator. The electric field produced may be sufficient to maintain a mean electron temperature of 10^6 to 10^{8}°K in the levels likely to emit radio-frequency radiation. Near sunspots, much more intense electric fields can maintain electron temperatures of the order of 10^{10}°K. There are several regions above a spot capable of absorbing radiation at each frequency. For one of these regions the absorption (and therefore the radiating power) is very great, but radiation emitted by the region can only be propagated towards the centre of the sun. Two other regions have a high absorption (each absorbing one of the two circularly polarized components), and radiation from both can escape from the sun, but at different intensities. The observed radiation therefore appears circularly polarized, the sense of the polarization corresponding to that of the more intense wave. A. HU.

523.72 : 621.472

1651. Utilization of solar energy. TROMBE, F. *Research, Lond.*, 393–9 (*June*, 1948).—After a historical survey, the production of high temperatures by concentration of solar energy in modern optical systems is discussed. A description is given of Cohn's solar furnace and, in full detail, of the high-temp. equipment and methods used at the Meudon Observatory solar lab. ThO_2, ZrO_2, MgO, BeO, CaO, Cr_2O_3, Al_2O_3, and rare-earth oxides can be melted in a few seconds. Continuous melting of refractory oxides was made possible by a recently developed system having an efficiency $\geqslant$ that of electrically heated systems, and giving much purer products. High-temperature NH_3 synthesis failed, but encouraging results were obtained for NO. The quartz apparatus used is described, and a comprehensive bibliography given. S. W.

523.73

1652. Spectroscopic determination of the sun's rotation period in sodium light. CIMINO, M. *Mem. Atti Accad. Naz. Lincei* (*Mem. Cl. Sci. Fis. Mat. Nat.*) **1** (*No.* 2) 45–61 (1946) *In Italian.*—The measures were made at the Solar Tower at Arcetri, Florence, in 1943, and are now reduced in detail. The rotation deduced from the D_1 band of Na is measurably longer than that from other wavelengths of the reversing layer, proving that the D band comes from a rather higher photospheric level than that of the reversing layer. Comparison with measurements of chromospheric arcs confirms this. T. L. MACD.

523.755 : 538.7 : 550.38

1653. Correlation of coronal and geomagnetic observations, 1944–1946. LINCOLN, J. V. AND SHAPLEY, A. H. *Trans. Amer. Geophys. Un.*, **29**, 849–54 (*Dec.*, 1948).—The intensity scales of the green emission line of the coronal spectrum at three observatories are intercompared, and the regions of activity in the corona are identified from the combined observations. The coronal-geomagnetic correlation has become weaker since minimum epoch of the sunspot cycle in 1944 and the apparent time relationship has shifted. A.

523.76

1654. Limb-darkening, temperature distribution and continuous absorption of the sun's atmosphere. UNSÖLD, A. *Z. Naturforsch.*, **3a**, 486–92 (*Aug.–Nov.*, 1948) *In German.*—Previous attempts to find the temperature distribution and the wavelength and depth dependence of the continuous-absorption coefficient of the sun's atmosphere lead to rather high values of the temperature limit ($T_0 \simeq 4\,900$–$5\,000$°K). An explanation is offered with references to an earlier paper [*Z. Astrophys.*, **22**, 356 (1944)]. It is concluded that the above temperatures are probably much too high. H. MO.

523.77

1655. Forbidden lines of oxygen in the solar spectrum. CABANNES, J. AND DUFAY, J. *C.R. Acad. Sci., Paris*, **226**, 1569–71 (*May* 19, 1948) *In French.*—Measures on the Utrecht photometric atlas confirm Sommer's identification of a forbidden line of OI at 5 577·346 Å in the solar spectrum, and add two further coincidences at 6 300·304 and 6 363·85 Å. The number of absorbing atoms, deduced from the equivalent widths, is too great to be accounted for by terrestrial absorption. Solar origin is supported by the deduced excitation temperature (5 800°) and the presence of faint emission in the chromosphere. D. L. E.

523.774

1656. Solar centre-to-limb variations of the profiles of Hα–Hζ. DE JAGER, C. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 9) 1159–68 (1948) *In English.*—Photographic determinations of the intensity profiles of the solar lines Hα, Hβ, Hγ, Hδ and Hζ are made at different distances from the centre of the disc. Various instrumental corrections are discussed. Satisfactory agreement is found with the profiles determined by other observers. A. HU.

523.78 : 526.6

1657. Determination of the instants of totality in solar eclipses. PLATZECK, R., MAIZTEGUI, A. AND GAVIOLA, E. *Nature, Lond.*, **163**, 63 (*Jan.* 8, 1949).—Gives details of a method of photography of the solar crescent during an eclipse to determine accurately the time of totality and thence the co-ordinates of two widely separated places on the earth. The expected accuracy is stated. [See Abstr. 12 (1947)]. E. G. M.

523.841.11

1658. Light curve and spectrum variations of Nova RS Ophiuchi from 1933 to 1940. BERTAUD, C. *Bull. Astr., Paris*, **14** (*No.* 1) 61–8 (1949) *In French.*—A visual light curve of this recurrent nova is constructed from 2 023 observations by about 100 observers, and is compared with that of other "fast" novae. The spectrum variations are interpreted in terms of a model consisting of a small high-temperature nucleus surrounded by an extended atmosphere. A. HU.

523.842

1659. Idealised models and rectified light curves for eclipsing variables. RUSSELL, H. N. *Astrophys. J.*, **108**, 388–412 (*Nov.*, 1948).—The characteristics of an idealized model eclipsing system are discussed in detail. The process of "rectification" of the observational data is described, and practical suggestions are given. D. R. B.

523.842.3 : 522.983.13

Spurious periods in spectroscopic binaries. *See Abstr.* 1644

523.85 : 778.3

1660. New physical and photographical problems in research on gaseous nebulae. HAIDRICH, K. *Acta Phys. Austriaca*, **2** (*No.* 1) 57–100 (1948) *In German.*—Critical survey of various methods of nebular photography. Experiments with a new method of fixing ($Na_2S_2O_3$, NH_4NO_3, KOH, H_2O) lead to an increase of plate sensitivity. Photographs of planetary nebulae are used to discuss the appearance of OII and OIII lines, as well as possible identifications of AII and SII lines, and also to show the usefulness of H_α and H_β pictures. A. B.

523.852.3 : 522.615

1661. Six-color photometry of stars. VI. The colors of extragalactic nebulae. STEBBINS, J. AND WHITFORD, A. E. *Astrophys. J.*, **108**, 413–28 (*Nov.*, 1948).—Important results are derived from photoelectric measures in 6 colours, made on 8 nebulae using the 60 and 100 in reflectors. With a photomultiplier tube and two filters, magnitudes and colours of nebulae down to 18·2 m photographic have been determined. Comparisons of the measured radiation with that of stars shows an excess in the u.v. and i.r. regions. Tentative conclusions are reached as to reddening and distance/velocity relations but difficulties arise if the reddening is assumed to be due to interstellar absorption. The results presented will affect earlier conclusions as to the meaning of the nebular counts, which may need revising. [See Abstr. 12 (1948)]. E. G. M.

523.87

1662. Spectrophotometric gradients of some Wolf-Rayet, O and B stars. PETRIE, W. *Publ. Dom. Astrophys. Obs. Vict., B.C.*, **7**, 383–94 (*Oct.*, 1947).—Gradients of 39 stars from 300 slitless spectra are given, reduced to the Greenwich system. Relative gradients between individual stars indicate large differential interstellar reddening, though they were in the Cygnus group and might be expected to show only small differences. Correlations of gradients with colour excesses and interstellar K lines are used to yield mean unreddened gradients for groups of stars, but it was not possible to find true temperatures for individual stars. D. L. E.

523.87 : 538.615

1663. The magnetic field of Gamma Equulei. BABCOCK, H. W. *Astrophys. J.*, **108**, 191–200 (*Sept.*, 1948).—As determined by an analysis of the Zeeman effect, the strongest stellar magnetic fields are found in the peculiar stars, types A and early F, particularly in spectrum variables. Not all of the obsd. fields are variable. Magnetic polarity is found +ve for γ Equu., and −ve for 78 Virg. Field strength for γ Equu. is 1 900 ± 250 gauss; and the ratio (magnetic moment)/(angular momentum) is $-1{\cdot}0\times10^{-15}$, in agreement with this ratio for Sun, Earth and 78 Virg. D. R. B.

523.872 : 535.338.4

1664. Intensities of molecular bands in the spectra of three early R-type stars. MCKELLAR, A. AND BUSCOMBE, W. *Pub. Dom. Obs. Vict., B.C.*, **7** (*No.* 24) 361–81 (1948).—The intensities of molecular bands due to CN, CH and C_2 in the spectra of 3 R-type stars have been measured, and the amount of the band absorption on the colour index is found to be small. The theory and method of calculating excitation temperature using the intensities of the bands is described and the resulting temperatures are compared with independent photoelectric colour temperatures made at Lick Observatory and are in reasonable agreement. E. G. M.

523.873 : 523.832

1665. Wavelength standards for radial-velocity determinations. III. The A stars with single-prism dispersion. PETRIE, R. M. *J. Roy. Astr. Soc. Can.*, **42**, 213–19 (*Sept.–Oct.*, 1948).—Radial-velocity standards for single-prism spectra of A-type stars are given from 124 spectrograms of 20 stars. The wavelengths were predicted from high-dispersion spectra in conjunction with control velocities supplied by members of known clusters and some visual binaries. The radial velocities of 21 A stars are given. A. HU.

523.873 : 523.832

1666. Wavelength standards for radial-velocity determinations. IV. The solar-type stars with low dispersion. MCDONALD, J. K. *J. Roy. Astr. Soc. Can.*, **42**, 220–5 (*Sept.–Oct.*, 1948).—A list is given of wavelengths for radial-velocity determinations from low-dispersion spectrograms of F4 to K8 stars. The selection of 19 standards is based on a line-by-line study of 79 spectrograms of standard objects, in conjunction with solar wavelengths. Radial velocities of 11 stars determined from the adopted wavelengths show satisfactory agreement with other determinations. A. HU.

523.873 : 538.615

1667. Test for a magnetic field in the white dwarf 40 Eridani B. BABCOCK, H. W. *Publ. Astr. Soc. Pacific*, **60**, 368–70 (*Dec.*, 1948).—A spectrogram of this star taken with a double circular analyser shows no evidence of duplicity of the Balmer lines, nor of any wavelength displacements between R.H. and L.H. analysed spectra. Paschen–Back splitting can therefore scarcely be a major factor contributing to the widths of the lines. A. HU.

523.874 : 522.614.3

The rapid determination of stellar radial velocities. *See Abstr.* 1641

523.877

1668. A stellar model for red giants of high central temperature. RICHARDSON, R. S. AND SCHWARZSCHILD, M. *Astrophys. J.*, **108**, 373–87 (*Nov.*, 1948).—It is assumed that the convective core emits a field of acoustical compression waves strong enough to carry the entire energy flux through a surrounding isothermal zone to the radiative envelope. The model gives radii as large as those of late-type giants, even if the central temperature is adjusted to be high enough for the carbon cycle. R. A. N.

523.877 : 523.823.5

1669. The interior temperature of super-dense dwarfs and the appearance of Bose degeneration. BIERMANN, L.. *Z. Naturforsch.*, **3a**, 481–5 (*Aug.–Nov.*, 1948) *In German.*—Since stars of small brightness exist amongst all colour classes, the term "white dwarf" is replaced by "super dense" which refers to the common characteristic. In the interior of such stars, temperatures of $\sim 10^6$ degrees are found. Together with the extremely high density this leads to degeneration (in the sense of statistical mechanics) and of free electrons of light nuclei. H. MO.

525.24 : 530.1 : 538

Sun's magnetic field [Blackett's theory]. *See Abstr.* 1676

526.71/.72 : 529.786 : 550.3

1670. Pendulums and the attraction of the moon and sun. STOYKO, N. *Bull. Astr., Paris*, **14** (*No.* 1) 1–36 (1949) *In French.*—Formulae are derived for the corrections to the period of a pendulum due to the attraction of the sun and moon; diurnal and semi-diurnal terms are considered in detail, and allowance is made for the deformability of the earth. The results are compared with observation, using a non-gravitational clock as a standard. The calculated values of certain constants arising from terrestrial elasticity are found to agree with determinations by other methods. R. A. N.

526.841 : 513.76 : 621.396

1671. The construction of zenithal-equidistant maps. MITCHELL, H. T., KILVINGTON, T. AND THOMSON, W. E. *P.O. Elect. Engrs J.*, **41**, 85–91 (*July*, 1948).—The Post Office has constructed a large number of zenithal-equidistant maps each giving great-circle bearing, distance and path, from its centre to any other point on the earth. The data were obtained, in the earlier cases, from an oblique stereographic graticule for the centre in question; later, bearing and distance were obtained by means of the Navicard, a graphico-mechanical device. P. O.

PHYSICS 53

53.08

1672. The numerical analysis of records to eliminate time-lag. HILL, A. V. *J. Sci. Instrum. Phys. Ind.*, **26**, 56–7 (*Feb.*, 1949).—A physical change F occurring as a function of time t is recorded as a deflection z differing from F owing to time-lag in the instruments. The recording system is assumed to have "additive" properties. Given z it is required to determine F. A record is made of the deflection y resulting from a short unit "pulse" of the physical quantity investigated. If z_1, z_2, z_3... are the observed values of z at intervals equal to duration of the pulse, then the following equations apply for any integral value of r

$$F_r = a_1 z_r + a_2 z_{r-1} + a_3 z_{r-2} + \ldots + a_r z_1.$$

Here F_r is the required value of F after r intervals and a_1, a_2, a_3... are constants characteristic of the instruments which can be determined once and for all, for a given setting, from the observed form of the deflection y. The calculations required can be readily made with an adding machine. Examples are given of problems to which the method is applicable. A.

53.081.5

1673. Dimensional analysis: an approach from transformation theory and a criterion for scaling model experiments. DECIUS, J. C. *J. Franklin Inst.*, **245**, 379–87 (*May*, 1948).—Transformation theory is used to determine the invariants of a general physical equation. Its application renders it possible to use empirical information, consistent with a given invariant condition on a given scale, to predict a physical relation on any other scale. The necessary and sufficient condition that scaling be possible is stated, and an example is given of the application of the transformation theory and of the scaling criterion to the problem of flow of fluids. G. G.

53.081.5 : 539.382

A paradox in dimensional theory. *See Abstr.* 2162

53.081.6 : 539.15

The fine-structure constant. *See Abstr.* 2043

53.081.7

1674. Selected values of properties of hydrocarbons. *Circ. U.S. Bur. Stand.* (*No.* 461) 493 *pp.* (1947).—An extensive collection of tables prepared by the American Petroleum Institute Research Project. Contains the following information for paraffins, acetylenes, olefines, alkyl-benzenes, -cyclopentanes, -cyclohexanes and styrenes, as well as for simple gases such as O_2, H_2, N_2, H_2O, CO, CO_2: density, b.p., m.p., refractive index, viscosity, vapour pressure, entropy, latent heats, heat of combustion, heat of formation, specific heat and other thermodynamic constants. Tables of fundamental constants, conversion factors, useful equations and extensive references are given.

53.082 : 541.183

Area estimation by gas adsorption. *See Abstr.* 2182

FUNDAMENTALS 530.1

530.1 : 521.038

1675. Remark on the gyromagnetic ratio for astronomical bodies and elementary particles. BRANDMÜLLER, J. *Z. Naturforsch.*, **3a**, 260–3 (*May*, 1948) *In German.*—Jordan's conception of a variable

gravitational constant G is used to generalize Blackett's expression for the ratio of the magnetic moment to angular momentum; in applications to a celestial body, G is put equal to its value at the time of formation of that body, but for elementary particles G is put equal to its value at the origin of the universe. R. A. N.

530.1 : 525.24 : 538.1

1676. The magnetic field of massive rotating bodies. BLACKETT, P. M. S. *Phil. Mag.*, **40**, 125–50 (*Feb.*, 1949).—A continuation of previous work [Abstr. 1715 (1947)]. Recent experimental measurements of the magnetic field inside the earth's crust are described. These offer the possibility of a proof that the outer layer of the crust contributes to the earth's external magnetic field, although it is the seat of neither electric currents nor charges. These experiments alone can, in principle, prove the existence of a new property of matter; but the results are still inconclusive. Recent experimental measurements by Babcock of the magnetic field of certain stars is described and evidence concerning the nature of the sun's magnetic field and its radial limitation is discussed. Some recent work on the origin of the secular variation of the earth's field is reported. Two hypotheses regarding the origin of the earth's magnetism are considered; each is consistent with present observations. The magnetic field of white dwarfs is studied in an appendix. L. S. G.

530.12

1677. Canonical co-ordinates in general relativity. NARLIKAR, V. V. AND PRASAD, A. *Bull. Calcutta Math. Soc.*, **40**, 123–8 (*Sept.*, 1948).—The gravitational metric is derived in canonical co-ordinates involving directly the values of the 20 Riemann–Christoffel components at the origin. The derivation implies solving a set of 100 linear equations. The field equations and several tensor conditions are expressed in the neighbourhood of the origin in terms of the constant components. The nature of the geodesics and the velocity of light in the neighbourhood of the space-time origin are discussed. A.

530.12

1678. On multivectors in a V_n. I. WRONA, W. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 10) 1291–301 (1948) *In English.*—Some new affinors are defined and used to express the conditions that a V_n should be Einsteinian or conformal to a flat space. The conditions are interpreted geometrically in terms of the scalar curvature of an m-direction. L. S. G.

530.12 : 531.51

1679. On Einstein's generalized theory of gravitation. NARLIKAR, V. V. AND TIWARI, R. Letter in *Curr. Sci.*, **17**, 355 (*Dec.*, 1948).—An advance notice of a paper on Einstein's generalized theory of gravitation [Abstr. 2008 (1948)]. Maxwell's equations are written down, including the interaction term between gravitation and electromagnetism which arises in this theory and which is evaluated in the simplest case of interest. H. B.

530.12 : 538.3

1680. On the metric of space and the equations of motion of a charged particle. MOSHARRAFA, A. M. *Proc. Math. Phys. Soc. Egypt*, **3**, 19–24 (*May*, 1945) *In English.*—Geodesic equations obtained for the metric $ds^2 - g_{\mu\nu}dx^\mu dx^\nu - 2f_\mu dx^\mu ds = 0$ are interpreted as the equations of motion for a charged particle. R. A. N.

530.12 : 538.3

1681. A relativistic cut-off for classical electrodynamics. FEYNMAN, R. P. *Phys. Rev.*, **74**, 939–46 (*Oct.* 15, 1948).—Ordinarily it is assumed that interaction between charges occurs along light cones, that is, only where the 4-dimensional interval $s^2 = t^2 - r^2$ is exactly zero. The author discusses the modifications produced if, as in the theory of Bopp [Abstr. 1620 (1946)], substantial interaction is assumed to occur over a narrow range of s^2 around zero. This has no practical effect on the interaction of charges which are distant from one another by several electron radii. The action of a charge on itself is finite and behaves as electromagnetic mass for accelerations which are not excessive. There also results a classical representation of the phenomena of pair production in sufficiently strong fields. A.

530.14 : 537.122 : 538.691

1682. Motion of an electron in the field of a magnetic pole. HARISH-CHANDRA. *Phys. Rev.*, **74**, 883–7 (*Oct.* 15, 1948).—In spite of its magnetic moment the electron has no bound states. A.

530.14 : 539.152.1

1683. Canonical transformations of the Hamiltonian in meson field theory. LE COUTEUR, K. J. AND ROSENFELD, L. *Phil. Mag.*, **40**, 151–7 (*Feb.*, 1949).—The consequences of Dyson's canonical transformation [Abstr. 3108 (1948)] are studied. In contrast to the pseudoscalar case, the transformation for the scalar case is closely related to that introduced in the M–R theory [Abstr. 740 (1947)], in order to separate the static part of the nuclear interactions. The non-static interaction of the first order can be made to cancel; and the expression for the first-order interaction in the pseudovector case can be considerably reduced. L. S. G.

530.14 : 539.18

1684. Infinite representation of the Lorentz-transformation and the mass problem. WESSEL, W. *Z. Naturforsch.*, **3a**, 559–64 (*Aug.–Nov.*, 1948) *In German.*—[Abstr. 1862 (1947)]. A theory of particles leading to mass quantization is sketched. Meson masses are found sufficiently in agreement with those experimentally determined to support the theory which relies on yet unproved assumptions (e.g. regarding infinite representations of the Lorentz group). H. MO.

530.145

1685. The two-distinct-times characteristic of wave mechanics. DE DONDER, TH. *Bull. Acad. R. Belge Cl. Sci.*, **34** (*No.* 4) 314–16 (1948) *In French.*—A wave-equation in 5-dimensional space is discussed, the fifth co-ordinate, the second time, being related as usual to the mass. The equation used includes an external field. G. J. K.

530.145

1686. Remarks concerning the hydrogen eigenfunctions in Dirac's theory. BETHE, H. A. *Z. Naturforsch.*, **3a**, 470–7 (*Aug.–Nov.*, 1948) *In German.*—

The virial theorem of Dirac's theory is derived in a very simple manner. With its help it is shown that the expectation value of Dirac's operator β in a Coulomb field equals W/mc^2. Dirac's eigenfunctions in momentum space are calculated for positive and negative energies. The mean values of potential and kinetic energy are calculated, including terms of the order of Sommerfeld's fine-structure constant without the use of explicit relativistic eigenfunction. H. MO.

530.145

1687. Note on Dirac's treatment of the harmonic oscillator. LANDSBERG, P. T. *Phil. Mag.*, **39**, 1001–4 (*Dec.*, 1948).—Certain asymmetrical properties of 2 of the (infinite) matrices of Dirac's treatment are explained, by analysing the limit problems involved, and by considering the matrices as being generated, not in a plane, but on the surface of a cylinder. L. S. G.

530.145

1688. Superquantization. II. GROENEWALD, H. J. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 9) 1091–103 (1948) *In English.*—Previous work [Abstr. 444 (1949)] is continued. Various types of dynamical operators are derived and used in a discussion of particles of spin 0 and spin 1. Results obtained are compared with those of other quantum theories. It is demonstrated that all present theories can be derived from the ordinary theory of particles, without a further process of quantization. The ordinary theory is equivalent to Dirac's 1942 theory. L. S. G.

530.145

1689. On the possible types of interaction between spinorial and tensorial fields. WATANABE, S. *Phys. Rev.*, **74**, 1864–6 (*Dec.* 15, 1948).—In the 5-dimensional formulation of field theories with interaction, the condition of 5-dimensional covariance limits the possible interactions between a spinor (Dirac) field and an electromagnetic or meson field to 3 types only, involving either pseudoscalar, vector or pseudovector coupling. The interaction through the fifth component may directly correspond to mass changes due to the interaction. From explicit expressions in 4 dimensions it is concluded that the second and third types have applications to interactions with an electromagnetic and meson field respectively. G. J. K.

530.145 : 530.12

1690. Co-ordinate operators in quantum mechanics. FLINT, H. T. Letter in *Nature, Lond.*, **163**, 131–2 (*Jan.* 22, 1949).—Continuation of author's previous paper [Abstr. 3597 (1948)]. A more general form of co-ordinate operator is discussed. H. McM.

530.145 : 535.14

1691. Radiation damping of an oscillator. BAUER, H. AND JENSEN, H. *Z. Phys.*, **124** (*Nos* 7–12) 580–5 (1948) *In German.*—Deals with the behaviour of wave packets of oscillator eigenfunctions. It is shown that such packets keep together, even when the effect of radiation is considered. The result is known, but it is claimed by the authors that their proof is simpler and more concise than that of F. Bloch [Abstr. 1259 (1928)]. H. MO.

530.145 : 535.14

1692. Phenomenological quantum-electrodynamics. JAUCH, J. M. AND WATSON, K. M. *Phys. Rev.*, **74**, 950–7 (*Oct.* 15, 1948).—The quantization of the pure radiation field in a uniformly moving refractive medium is carried through both in the Hamiltonian and in the symmetrical 4-dimensional form. The total energy and momentum are diagonalized. For a medium velocity $> c/n$ there occur photons with negative energy. A.

530.145 : 537.12

1693. The e^4 approximation of the self-energy of the electron treated by analytical continuation. NILSSON, B. *Ark. Mat. Astr. Fys.*, **36 A** (*Paper* 5) 13 *pp.* (1948) *In English.*—Although the Riesz analytical continuation method of solution of the equations gives a finite answer to the first (e^2) approximation, the next approximation still retains terms equivalent to a logarithmic divergence of the ordinary theory. That this type of divergence is not affected is a general consequence of the method. The calculation is carried through by a simplified method due to Pauli, where the variable of the continuation is introduced directly into the commutation rules. G. J. K.

530.145 : 537.122

1694. A note on the magnetic moment of the electron. LUTTINGER, J. M. *Phys. Rev.*, **74**, 893–8 (*Oct.* 15, 1948).—Recent experiments seem to require a modification in the g-factor of the electron. It has been suggested that the coupling between the electron and the radiation field is responsible, and Schwinger has calculated the effect on the basis of a general subtraction formalism for the infinities of quantum electrodynamics. It is here shown that the change in magnetic moment may be derived very simply without any reference to an elaborate subtraction formalism. A.

530.145 : 537.122

1695. On the boundary conditions in the theory of the point electron. CALDIROLA, P. Letter in *Nuovo Cim.*, **5**, 99–100 (*April*, 1948) *In Italian.*—Dirac's classical 3rd-order equation of motion for the electron is generally solved by assigning initial position and velocity, and a suitable asymptotic behaviour for $t \to \infty$. The author observes that only initial conditions should intervene, and suggests a generalized inertia principle postulating that only those solutions of Dirac's equation have a physical reality, that reduce to a rectilinear uniform motion on adiabatically annulling the parameters which represent the external forces. L. P.

530.145 : 538.1

1696. On the generalised transformation functions. TANIKAWA, Y. *Progr. Theor. Phys.*, **1**, 12–20 (*July* 1, 1946) *In English.*—It is shown that, using the Tomonaga many-time formalism of the quantum theory of electromagnetic fields, these functions can be constructed and only have meaning when applied to the region between two space-like surfaces in 4-dimensional space. Such a function then gives the *a priori* probability of the results of observations of the field variables at points on these surfaces. G. J. K.

530.145 : 539.17

1697. Notes on Feenberg's series—rearrangements. RICHARDS, P. I. Letter in *Phys. Rev.*, **74**, 835–6 (*Oct.* 1, 1948).—Some expressions used by Feenberg in a discussion of particle scattering [Abstr. 856 (1949)] are discussed more simply by introducing a new notation which enables the expressions to be

handled in closed form. Only algebraic aspects, excluding convergence, are discussed. L. S. G.

530.145 : 539.18

1698. Field mechanical derivation of Dirac's wave equation. Bopp, F. *Z. Naturforsch.*, **3a**, 564–73 (*Aug.–Nov.*, 1948) *In German.*—From a generalized linear electrodynamics an equation of motion is obtained which has also been the subject of papers by Hönl and Papapetrou [Abstr. 2244 (1939), 1082 (1942)]. A distinction must be made between macro- and micro-velocity of the particle. Energy and charge centre are displaced because of an oscillation due to emission-reabsorption processes. An additional moment appears which, in the present paper, is found identical with the electron gain when Maxwell's equations are suitably modified. Quantization of the above equations of motion leads to a wave equation whose solutions contain those of Dirac's equation. Particles of slow oscillation are shown to be heavy particles. H. MO.

530.145 : 539.18

1699. Mechanics and mass spectrum of fundamental particles. Hönl, H. *Z. Naturforsch.*, **3a**, 573–83 (*Aug.–Nov.*, 1948) *In German.*—The classical dynamics of a new species of particles is developed with reference to earlier papers, e.g. Hönl, Papapetrou [Abstr. 3005 (1939), 1082 (1942)]. Mass dipoles and mass multipoles are introduced as well as simple poles. The dynamics is obtained from a suitable Lagrangian. This leads to a classical analogue of a Dirac particle for the pole-dipole case, but the mass term has a more intricate structure. The correspondence between the classical theory and the quantum theory of mesons is discussed. The classical theory shows a distinction between inner and outer variables corresponding to spin operators and momentum operators. The spin operators of a hierarchy of particles (corresponding to multipole particles) are chosen according to de Broglie's method of fusion. The mass terms are the "centre" of the spin operator algebra. Its irreducible representations correspond to the spectrum of possible masses. The mass spectrum of the pole-dipole particle is found by application of the correspondence principle. The paper concludes by discussing the origin of cosmic radiation. The theory is closely related to that of Bopp [see Abstr. 1698 (1949)]. H. MO.

530.145 : 539.18

1700. On the mesic charge. Okayama, T. Letter in *Phys. Rev.*, **75**, 308 (*Jan.* 15, 1949).—It is argued that whereas the Dirac hole theory can be applied when an electron interacts with a vector Maxwell field, it cannot with a pseudovector Maxwell field, because electric charge would not be conserved. This argument can be applied to the interaction between a nucleon described by hole theory and any of the various meson theories. If conservation of the meson charge of the nucleons is assumed then many of the usual types of interaction are ruled out. G. J. K.

530.145 : 539.185 : 537.13

1701. The magnetic moments of the neutron and proton. Luttinger, J. M. Letter in *Phys. Rev.*, **75**, 309–10 (*Jan.* 15, 1949).—A method previously used to calculate the magnetic moment of the electron [Abstr. 1694 (1949)] has been applied to this problem with a pseudoscalar meson theory and a hole theory for the nucleon. Neutral, charged or symmetric theories all give incorrect results for the magnetic moments μ_n, μ_p, or the ratio μ_n/μ_p, with either of the possible types of coupling. G. J. K.

530.145.6

1702. The factorization method, hydrogen intensities, and related problems. Hull, T. E. and Infeld, L. *Phys. Rev.*, **74**, 905–9 (*Oct.* 15, 1948).—The factorization method enables one to calculate in an elementary way the discrete-discrete and discrete-continuous transition probabilities of hydrogen atoms by means of recurrence formulae. From a key intensity all others are found by a repeated application of an l-changing recurrence formula or an n'-changing operator. A.

530.145.63 : 538.11

1703. Note on Dirac's theory of magnetic poles. Wilson, H. A. Letter in *Phys. Rev.*, **75**, 309 (*Jan.* 15, 1949).—A derivation of the Dirac equation $e_0 g_0 = \frac{1}{2}\hbar c$ [Abstr. 859 (1949)], where e_0 and g_0 are the elementary point electric and magnetic pole strengths, is derived from an expression for the angular momentum of the field. G. J. K.

530.145.7

1704. Remarks on the determination of a central field of force from the elastic scattering phase shifts. Bargmann, V. *Phys. Rev.*, **75**, 301–2 (*Jan.* 15, 1949).—It is shown by an explicit example that a central field of force is not uniquely determined by the phase shifts for an S-wave. Hylleraas' paper [Abstr. 2725 (1948)] is discussed, and an error in his argument is pointed out. A.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.1

1705. On integrals in kinematics. Blaschke, W. *Arch. Math.*, **1** (*No.* 1) 18–22 (1948) *In German.*

531.19 : 548.7

On statistical mechanics of order-disorder transformations. *See Abstr.* 2199

531.224.8 : 621–272

1706. On highly compressible helical springs and rubber rods, and their application for vibration-free mountings. I. Haringx, J. A. *Philips Res. Rep.*, **3**, 401–49 (*Dec.*, 1948).—The elastic stability is studied of helical springs under compression, or under combined compression and twist. If the problem is simplified by replacing the helical spring by an elastic prismatic rod, its rigidity with respect to shearing must be referred to the transverse force acting in that plane which in the unloaded state is normal to the central line of the rod, but is no longer so in the deflected state. A new relation is deduced between the relative compression at which buckling occurs and the ratio length/dia. of the spring. For this ratio there exists a limiting value below which no buckling occurs, not even under complete compression, and which is dependent only on the method of fixing the spring ends. A more accurate calculation, which

takes the helical structure of the spring into account, confirms that the wire dia. and the number of coils are of secondary importance provided that the pitch of the helix is less than, say, half its diameter. A.

531.3 : 521.13

The distribution of Jacobi constants in three dimensions. *See Abstr.* 1638

531.353 : 521.134

Orbits round two fixed centres. *See Abstr.* 1640

531.44 : 536.21 : 621.316.3.066.6

The temperature in a sliding contact. *See Abstr.* 1861

531.66 : 539.8

1707. High-velocity particles produced at impact. McMillen, J. H. and Kramer, R. L. Letter in *Phys. Rev.*, **74**, 1882 (*Dec.* 15, 1948).—Impact of a steel ball at 7 000 ft/sec on a Cu wire grid was found to produce wire fragments with velocities up to 20 000 ft/sec in the forward direction, and others with velocities up to 5 000 ft/sec in the opposite direction. The explanation is not known. G. O. B.

MECHANICAL MEASUREMENTS 531.7

531.7 : 536.48 : 537.312.62 : 621.317.39

1708. Liquid-helium depth gauge. Feldmeier, J. R. and Serin, B. *Rev. Sci. Instrum.*, **19**, 916–17 (*Dec.*, 1948).—Ta becomes superconducting at 4·3°K which is close to the normal boiling point of liquid He, and the resistance of a vertical Ta wire stretched in a liquid He container is found to serve as a convenient depth gauge. D. S.

531.717.1 : 534.321.9

1709. A portable ultrasonic thickness gauge. Evans, D. J. *Non-Destr. Test.*, **6**, 22–4, 42 (*Spring*, 1948).—A description is given in simple terms of the "Audigage," a small portable instrument operated from dry batteries for measuring the thickness of steel objects $\frac{1}{8}$ to 12 in thick which are accessible from one side only. The instrument is similar in principle to the Sonigage and employs a quartz crystal 1 in² in area, operating over the range 1·4 to 2·8 Mc/s, which excites thickness vibrations in the material under test, the resonant condition being detected by means of an audible note in headphones. Thicknesses are determined by measuring the frequency difference between any 2 harmonics; a scale on the instrument converts this directly to inches of steel. H. J. H. S.

531.72

1710. Pneumatic measurement of cross-sectional variations in textile slivers and insulated wire. Barrell, H. and Buxton, W. L. *J. Sci. Instrum. Phys. Ind.*, **26**, 105–8 (*March*, 1949).—A standard type of air controller associated with simple measuring units is used to determine variations in the cross-sectional area of materials in thread or wire form. The materials are drawn through a pair of orifices set in opposite faces of a small chamber connected to the controller. Variations in cross-sectional area cause alterations in the resistance to escape of air from the controller which are registered as pressure changes on a water manometer. The apparatus should be calibrated with specimens having the same average qualities, either of fibre diameter or surface condition, as those of the material to be measured. A.

531.743.2 : 548.0

A new theodolite goniometer. *See Abstr.* 2192

531.78.082.72 : 621.317.39.082.72

1711. A capacitance dynamometer. Bordoni, P. G. *Ric. Sci.*, **17**, 1371–5 (*Sept.–Oct.*, 1947) *In Italian.*—The parallel-plate capacitor is enclosed in a box, one plate attached to the rigid bottom, the other to a thin plate of the material under test forming the lid. The deflection of the lid under the action of a given weight is measured by the change in capacitance, as indicated by the frequency change of an oscillatory circuit including the capacitance, using a beat-frequency method with another oscillatory circuit whose frequency corresponds to zero deflection of the dynamometer capacitor. A null method may also be used, by means of a variable capacitor (micrometer). The apparatus is suitable for high-precision measurements. J. A. W.

531.78.082.73 : 621.9.012 : 621.317.39.082.73

1712. Piezoelectric dynamometer for recording variations in cutting forces. Naslin, P. *Rev. Gén. Élect.*, **57**, 361–4 (*Sept.*, 1948) *In French.*—The piezoelectric and mechanical properties of quartz are outlined. Difficulties in application, due to the smallness of the charges and the need for excellent insulation, are discussed. In the apparatus described the thrust is transmitted by a stack of four crystals with alternate interleaved connections; the stack is mounted in a hollow metal block with a piston ensuring parallel movement. The cavity is kept dry by P_2O_5; amber is used for the insulators. The output is connected by a coaxial cable to an electrometer valve followed by a d.c. amplifier working an oscillograph. Thrusts up to 1 000 kg are measured with an accuracy of 1%. C. F. B.

531.788.7 : 536.23

Relation between thermal conductivity of gas and sensitivity range of Pirani gauge. *See Abstr.* 1862

531.791 : 621.318.572

1713. An electrical recording device for counting objects simultaneously in groups and individually. Mackay, I. and Powell, E. O. *J. Sci. Instrum. Phys. Ind.*, **25**, 404 (*Dec.*, 1948).—By the manipulation of a single switch the instrument records on two telephone message registers (1) the number of groups of objects studied, (2) the total number of objects in the groups. The switch is foot-operated so that the user's hands are free. A.

MECHANICS OF FLUIDS 532

532.123 : 532.13 : 532.595

1714. Elastic-viscous oleate systems containing KCl. I. Measurements of the elastic properties. Dependence of period and damping on the temperature. Bungenberg de Jong, H. G. and v.d. Berg, H. J. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 10) 1197–210

(1948) *In English.*—Solutions of Na oleate (1·2%) containing KCl are placed in spherical glass vessels and set in vibration. By observing with a telescope a small air bubble in the viscous solution the period of the vibrations and the damping were measured. Several methods of imparting the initial impulse were used and the effect of air bubbles, temperature, etc., on the elastic behaviour was examined. J. I.

532.123 : 532.595

1715. Damped oscillations of a spherical mass of an elastic fluid. BURGERS, J. M. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 10) 1211–21 (1948) *In English.*—The theory is given of oscillatory movements observed in certain soap solutions by de Jong [Abstr. 1714 (1949)]. The oscillations involve motion in concentric spherical layers, and motion in meridian planes. Values of the damping coefficients are derived in cases where the damping is due to viscous action, to relaxation of elastic stress, or to slipping of the fluid along the wall of the containing vessel. The results show that the log. dec. is inversely proportional to the radius of the containing vessel in the case of viscous damping, directly proportional to radius in the case of relaxation, and independent of radius in the third case. Numerical values are obtained with special reference to de Jong's experimental work. G. G.

532.13 : 541.64 : 621.317.39

1716. Measurements of the mechanical properties of polymer solutions by electromagnetic transducers. SMITH, T. L., FERRY, J. D. AND SCHREMP, F. W. *J. Appl. Phys.*, **20**, 142–53 (*Feb.*, 1949).—A concentrated polymer solution is sheared by a rod oscillating axially with a very small amplitude in a closed tube. The rod is driven by a coil in a magnetic field; from electrical measurements on the coil, the mechanical resistance and reactance of the system are calculated by transducer relationships. Equations are given for obtaining the dynamic viscosity, η', and rigidity, G', of the solution. In the case of some polymer solutions, the audiofrequency range covered by the present apparatus falls in the dispersion zone where η' and G' change rapidly with frequency. In other cases the frequency range covered appears to be at the upper end of the dispersion zone; η' is $\ll$ the viscosity in steady flow, and G' changes very little with frequency. The advantages and limitations of the method are discussed. A.

532.133 : 532.739

1717. On the specific viscosity of solutions with lamellar molecules and its dependence on temperature. KUSS, E. AND STUART, H. A. *Z. Naturforsch.*, **3a**, 204–10 (*April*, 1948) *In German.*—The specific viscosity of solutions of substances with lamellar molecules (benzene derivatives) in various solvents, mostly in nitrobenzene and xylene, has been measured at various temperatures. The most important results are: (1) the unexpectedly high value of $d\eta/dT$, (2) the occurrence of negative η values, (3) sometimes a positive $d\eta/dT$. The results have been used for calculating such constants as the mutual-action energy and mutual-action viscosity, in accordance with a theory by one of the authors. F. L.

532.137

1718. A new capillary viscometer. GROVER, D. W. AND WERTHEIM, R. A. P. *Research, Lond.*, **1**, 618–24 (*Oct.*, 1948).—A reservoir, open to the air, is connected by a vertical capillary tube to an enclosed chamber; the liquid flows through the tube, causing the pressure in the chamber to increase. It is shown that if a certain function of this pressure is plotted against time, a straight line will result if the liquid is Newtonian; if not, the liquid is seen to be non-Newtonian from the result of a single test. Corrections may be applied for the vapour pressure of the test liquid, and other minor factors. Tests with sucrose solution (Newtonian) and sodium alginate solution (non-Newtonian) agree with previously obtained data. N. C.

532.137

1719. A falling-sphere viscometer for use with opaque liquids. THOMPSON, A. M. *J. Sci. Instrum. Phys. Ind.*, **26**, 75–6 (*March*, 1949).—A method is described for indicating the passage of the sphere past the reference marks of a falling-sphere viscometer. The method applies to opaque liquids and depends on the alteration of the inductance of a coil as the steel sphere passes through it. Two coils are used for each reference mark. They are connected in a bridge circuit which is balanced when the sphere passes the reference mark. Indication is obtained from a phase-selective rectifier and meter. A.

532.5.031 : 536.2 : 532.7

1720. The thermomechanics of ideal fluids. VERSCHAFFELT, J. E. *Bull. Acad. R. Belg. Cl. Sci.*, **34** (*No.* 4) 325–43 (1948) *In French.*—On the view that a gradient of temperature in a fluid acts as a motive force, a term depending on temperature is introduced into Euler's equations of motion, and a similar extension is made to the theorem of Bernoulli. Various problems of flow arising from initial gradients of temperature are considered and solutions obtained in accordance with the theory given. The process employed extends the theory of fluid motion to include effects of molecular motion as postulated in the kinetic theory of matter; and several problems are considered from this point of view. One result obtained by the application of the laws of thermomechanics is that the flux of heat conduction has, to a moving observer, the same intensity as to a stationary observer. G. G.

532.516

1721. Influence of external gas pressure on the oiliness of lubricants. VOLOVICK, G. *C.R. Acad. Sci., Paris*, **227**, 1354–6 (*Dec.* 20, 1948) *In French.*—The oiliness of 3 oils used in refrigerators was measured under conditions where the gas pressure could be varied. If the coefficient of friction of dry rubbing surfaces is F and the coefficient when lubricated is f then the oiliness (ϕ) of the lubricant is defined as $\phi = (F - f)/F$. When the gas surrounding the rubbing surfaces is at atmospheric pressure, ϕ increases with time and reaches a steady value. As the pressure is reduced, ϕ increases again in a series of steps. Pressures down to 10 mm Hg were investigated with air, CO_2, NH_3 and SO_2. The explanation is that the number of gas molecules in the lubricating layer is reduced as the pressure is reduced, thus increasing the number of oil molecules and hence the oiliness. J. I.

532.516 : 531.43/.46

1722. The incremental friction coefficient—a non-hydrodynamic component of boundary lubrication. BURWELL, J. T. AND STRANG, C. D. *J. Appl. Phys.*, **20**, 79–89 (*Jan.*, 1949).—In investigations of lubricated sliding friction between two crossed cylinders it is found that for hard, smooth surfaces the friction force is a straight-line function of the applied load, although this line does not generally pass through the origin. The slope of this line defines a friction coefficient, designated as the incremental friction $f\Delta$. It is independent of load and of viscous-fluid effects and hence permits investigation of non-fluid friction at reasonable speeds. It is often found to decrease with increasing speed, U, over at least part of the range, and this variation often appears to be a linear function of the log. of the speed. The curve of $f\Delta$ *vs.* ln U seems to be characteristic of the chemical structure of the lubricant and of the rubbing surfaces. A.

532.516 : 539.62

1723. Frictional levels. MARCELIN, A. *C.R. Acad. Sci., Paris*, **226**, 1584–5 (*May* 19, 1948) *In French.*—Experimental results obtained with an instrument termed a "frictiographe" are interpreted as signifying that a lubricating film comprises an integral number of double layers of molecules; the pile of layers in the film is termed a stratofilm having its own characteristic order determined by the number of double layers comprised in the film, and each layer is characterized by its own special coefficient of friction. Lubricant supplied between a rotating shaft and its bearing comprises a hydrodynamic region, including a minimum film thickness, and succeeded by a series of stratofilms in the region of the bearing. Characteristics of the frictional forces excited in the various regions as the shaft is accelerated are briefly described and illustrated. J. S. G. T.

532.517.4 : 533.6.013.22

The turbulence problem. *See Abstr.* 1749

532.526.032

1724. Some investigations on turbulent friction layers. WIEGHART, K. *Z. angew. Math. Mech.*, **25/27**, 146–9 (*Aug.–Sept.*, 1947) *In German.*—The velocity profiles for arbitrary pressure curves were always found approximately one-parametric, even behind considerable obstacles or along rough surfaces, in accordance with Gruschwitz's results (*Ing. Arch.*, **2**, 321 (1932)]. The law valid outside the laminar sub-layer and near the wall is $u/U \sim (y/\theta)^{1/7\cdot7}$ (where u = average veloc. in layer, U = velocity outside layer, y = dist. from wall, θ = density of impulse loss) and this despite the dissimilarity of turbulence characteristics (e.g. curves of shear stresses). On Prandtl's boundary layer theory a relation for the energy of friction layers may be derived in analogy with the impulse law. All these relations taken together enable a differential equation for $\eta(x)$ to be set up, corresponding to Gruschwitz's diff. eqn. which had been obtained empirically. However, the dynamic terms entering the diff. eqn. such as shear stress τ_0 near the wall, or work of the shear stresses, still evade determination, as their variation shows the most surprising discontinuities. However, these effects are not observed so long as $|\theta/U \times dU/dx| < 1 \times 10^{-3}$. B. F. K.

CAPILLARITY 532.6

532.613.4

1725. Interfacial tension at elevated pressures and temperatures. I. A new and improved apparatus for boundary-tension measurements by the pendent drop method. HAUSER, E. A. AND MICHAELS, A. S. *J. Phys. Coll. Chem.*, **52**, 1157–65 (*Oct.*, 1948).—Describes an apparatus for measuring the interfacial tension of a liquid/liquid system over temperature and pressure ranges of 0–200°C and 0–10 000 lb/in² respectively. L. G. C.

532.64

1726. A theory of the angle of contact. YARNOLD, G. D. AND MASON, B. J. *Proc. Phys. Soc., Lond. B*, **62**, 121–5 (*Feb.*, 1949).—It does not appear to be possible to give a quantitative account of the angle of contact of a continuous liquid in terms of cohesional forces. By using Young's energy relation and making allowance for the effects of adsorbed films on the surface of the solid, expressions are derived for the advancing and receding angles, and a general explanation of the hysteresis of the angle of contact is put forward. A.

532.64

1727. The angle of contact between water and wax. YARNOLD, G. D. AND MASON, B. J. *Proc. Phys. Soc., Lond. B*, **62**, 125–8 (*Feb.*, 1949).—The effects (*a*) of the velocity of the liquid surface, and (*b*) of the time of immersion, on the angle of contact between clean surfaces of water and wax have been investigated by a dynamical method. It is clear that Ablett's measurements are vitiated by the fact that the time of immersion is disregarded. The term "equilibrium angle of contact" appears to be meaningless. A.

532.69 : 551.577

Raindrop size, shape and falling speed. *See Abstr.* 2248

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 536.48

The theory of liquid helium. *See Abstr.* 1874

532.7 : 536.71

1728. A general kinetic theory of liquids. VI. The equation of state. RODRIGUEZ, A. E. *Proc. Roy. Soc. A.*, **196** (*No.* 1044) 73–92 (1949).—The paper studies an approximate equation of state, first derived by Green, which covers both phases, liquid and gas, and can be used for numerical evaluation. It contains explicitly the roots of a certain transcendental equation. The difference between the liquid and the gas corresponds to the existence or non-existence of real roots of this equation. The solution of the transcendental equation has been reduced, by using a suitable expansion, to the solution of an algebraic equation. In this way explicit expressions for the equation of state are obtained which, however, are too involved to be generally discussed. The theory can be applied to A using the Lennard-Jones potential for the interaction between A atoms, and the results are shown in diagrams. The character of the

singularity separating liquid and gas can be seen from these diagrams to lie at the lowest point of the isotherm in the unstable region. An estimate of the position of the critical point is made and found in fair agreement with the experimental data. A.

532.7 : 539.266

1729. Distribution of atoms in liquid mercury. HENDUS, H. *Z. Naturforsch.*, **3a**, 416–22 (*July*, 1948) *In German.*—Photographs were obtained in a 5·8 cm diameter camera with crystal-reflected Cu $K\alpha$ or Ag $K\alpha$ radiation. Photometer measurements agree well in the common $\sin\theta/\lambda$ range. Agreement with Menke [Abstr. 5057 (1932)] is fair, with Boyd and Wakeham [Abstr. 4442 (1939)] poor. Fourier synthesis show $\sim$ 6 neighbours at 3·0 Å, $\sim$ 4 at 3·47 Å (18°C). A. J. C. W.

532.739 : 532.133

The specific viscosity of solutions with lamellar molecules. *See Abstr.* 1717

532.74 : 534.321.9 : 534.845

Theory of ultrasonic absorption in unassociated liquids. *See Abstr.* 1764

532.77 : 541.8 : 541.123.2

1730. Correlating vapor compositions and related properties of solutions. *Industr. Engng Chem.*, **40**, 2118–24 (*Nov.*, 1948).—A method is presented for expressing as a sheaf of straight lines, data for binary solutions representing equilibrium conditions of temperature, pressure, and compositions of the liquid and vapour phases. The correlation is excellent throughout the entire range, including the critical. Lines of constant compositions in the liquid phase are drawn on log paper for a plot of the relative volatilities against the ratios for a reference substance of the specific volume of the vapour to the specific volume of the liquid, all at the same value of the reduced temperature. For all binary systems studied, these lines were straight; this allows ready interpolation, extrapolation and evaluation of experimental data. Other methods of logarithmic plotting with a reference substance are indicated and may be used in some cases, but do not always give the desired straight-line correlation. A.

532.782 : 548.73

1731. The coefficients of expansion of some solid solutions in aluminium. HUME-ROTHERY, W. AND BOULTBEE, T. H. *Phil. Mag.*, **40**, 71–80 (*Jan.*, 1949).—An experimental investigation of the expansion of some Al alloys. The aims were (1) to test the hypothesis that solid solutions might show increased or decreased coeffs. of expansion according as the lattice distortion is an expansion or contraction, (2) to examine the reproducibility of results obtained by carefully controlled X-ray methods. Mean coefficients of expansion were found over the ranges −50°C to 25°C and 25°C to 200°C. Results show that the coefficient of expansion of Al is increased by the solution of elements which produce an expansion (Mg) and a contraction (Zn, Li) of the lattice of the solvent; so the increase is not necessarily associated with an expansion of the lattice. The accuracy attainable in the experiments is discussed; it seems that for homogeneous alloys of cubic structure the X-ray method is to be recommended in cases where the X-ray diffraction pattern gives rise to a line of reasonably high angle. L. S. G.

MECHANICS OF GASES 533

533.15

1732. Thermo-osmosis of gases through a membrane. DENBIGH, K. G. Letter in *Nature, Lond.*, **163**, 60 (*Jan.* 8, 1949).—A gas flow against a pressure gradient is obtained through a thin rubber membrane across which a temperature gradient is maintained. Eventually static equilibrium is established. The flow is towards the higher temperature with CO_2 and in the reverse direction with H_2. The equilibrium pressures obey the equation $\{RT_1T_2/(T_2 - T_1)\}\log P_1/P_2 = Q = \text{const.} \simeq 308$ cal/mole for CO_2. (R = gas constant). Q is interpreted as the heat of transport which obeys the equation $dp/dT = -Q/VT$ where V is the molar volume. This equation, which also holds for the fountain phenomenon of He II [Abstr. 3381 (1939)] has been derived for irreversible processes by de Groot [Abstr. 3515 (1947)] from Onsager's reciprocity theorem. The actual figure for Q is believed to be somewhat higher because the measurements probably give too large values for the temperature difference across the membrane. H. L.

533.16 : 532.13 : 536.2

1733. A theory of viscosity and thermal conductance of liquids and highly compressed gases. PRASAD, B. *Phil. Mag.*, **39**, 884–9 (*Nov.*, 1948).—Assuming Andrade's theory [Abstr. 988, 1480 (1934)], an expression for the viscosity (η) of a liquid is obtained. Modifications of this formula, made by Andrade, are unnecessary on theoretical grounds and also [Abstr. 1493 (1942)] on the basis of experiment. The mechanism of thermal conductance of a liquid is the same as that of viscosity, and this fact leads to an expression for the conductance (K). For a highly compressed gas the mechanism for η and K is the same as for a liquid, as is shown by existing experimental data. L. S. G.

533.16 : 533.7 : 539.62

1734. Air friction on rapidly moving surfaces. KUHLTHAU, A. R. *J. Appl. Phys.*, **20**, 217–23 (*Feb.*, 1949).—The friction on a surface moving through air at high speed has been measured over a pressure range from 0·5 to 200 μ. A rotating-cylinder-type apparatus was used in which the inner cylinder was rotated at very high speed by means of an air turbine. The outer cylinder completely surrounded the inner cylinder and was supported coaxially with it by means of a torsion fibre so that the frictional torque on the rotating cylinder could be measured with precision. Observations were made at rotor speeds varying from 400 r.p.s. to 1 700 r.p.s. which corresponds to a linear velocity at the periphery of the rotor varying from 400 to 1 700 ft/sec. It was found that at all pressures the observed torque varied in an essentially linear fashion with the rotor speed. The relationship between torque and pressure at constant speed yielded a smooth curve indicative of ordinary viscosity, and this general form held for all speeds tested. However, the results could be explained by kinetic theory

treatment of viscosity only at pressures lower than 10 μ; i.e., below the point where the intermolecular collision frequency predominates over that of the collisions between the molecules and the walls. A.

533.27 : 541.124

1735. On a general form of the equations of kinetics of chemical reactions in gases. SEDOV, L. I. *Dokl. Akad. Nauk., SSSR.*, **60** (*No.* 1) 73–6 (1948) *In Russian.*—The general equations of motion of a mixture of an arbitrary number of gases are derived. Account is taken of chemical reactions between the gases, and the effects of diffusion and viscosity. The form of the equations is such that by slight modification they may be made applicable to three different cases: (*a*) when equilibrium exists between the reactants, (*b*) when there is a state of quasi-equilibrium, and (*c*) when conditions are far from equilibrium. A. SCH.

533.275 : 536.7

1736. A note on the thermodynamics of the wet- and dry-bulb hygrometer. NANDA, V. S. AND KAPUR, R. K. *Indian J. Phys.*, **22**, 391–6 (*Sept.*, 1948).—The paper deals with the thermodynamic study of the wet-and-dry bulb hygrometer as applied to other liquids besides water. Hygroscopic liquids are also included. The theory is found in reasonable accord with experiment. A.

533.5

1737. Metallic vessels and tubing for low pressure. DESCARSIN, M. *Le Vide*, **3**, 399–408 (*March*, 1948) *In French.*—A comparison is made between the use of glass and of metal, preferably electrically welded stainless steel, for the construction of high-vacuum plant. Installations are illustrated and described in detail, amongst them some resistance-heated vacuum furnaces for degassing parts of electronic and X-ray tubes. In one design for 75 and 120 kW respectively graphite resistors are used. A box pump and 2 diffusion pumps working in parallel maintain a pressure of 2×10^{-3} mm Hg for several hours. In another design the heating elements consist of a squirrel cage of 42 tungsten bars, 7 each connected to a 6-phase power supply. A box pump, a Hg-vapour diffusion pump acting as a booster, and a silicone oil diffusion pump maintain a vacuum of 10^{-5} mm Hg. The furnace consumes 30 kW and reaches a temperature of 1 800°c. The parts to be degassed are contained in a Mo cylinder arranged inside the squirrel cage. Some practical questions of high-vacuum technique, e.g. leak hunting, are briefly discussed. R. N.

533.5

1738. Vacuum fittings. LAURITSEN, C. C. AND LAURITSEN, T. *Rev. Sci. Instrum.*, **19**, 919–20 (*Dec.*, 1948).—Brief descriptions and diagrams are given: of a joint for tubing 1 to 12 in diameter; of several sliding and rotating seals; and of a device for locating, measuring and trimming an ion beam. Commercial gate and needle valves are usually satisfactory. S. J. G.

533.5

1739. Conductance of bends and concentric tubes of a vacuum system. SHERRIFF, E. V. *J. Sci. Instrum. Phys. Ind.*, **26**, 43–5 (*Feb.*, 1949).—Conductances in a vacuum system of right-angle bends and manifolds constructed of two concentric tubes were measured. The effect of a right-angle bend on the conductance of a tube can be represented by an additional tube length of one tube diameter. The conductance of a long regular annular space is given by a modified form of Knudsen's equation:

$$S=\frac{4\sqrt{(2\pi)}}{3}\left[\frac{(r_2^2-r_1^2)(r_2-r_1)}{L}\right]\frac{1}{\sqrt{\rho_1}}$$ A.

533.5 : 621.38

1740. Aspects of high-vacuum technique. OETJEN, G.-W. *Elektrotechnik, Berlin*, **2**, 333–40 (*Dec.*, 1948) *In German.*—A survey of modern development with regard to the two principal aims: (1) to reduce the pressure in a given volume within a definite time to a desired value while the course of the process is supervised by continuously readable and as far as possible inertia-free instruments, and (2) to remove gases and vapours flowing through the apparatus including those produced by porosity and gassing of the walls at a given pressure. Tables and graphs give data on rotary, ejection and diffusion pumps and on complete pumping units, the properties of working fluids, and on the co-ordination of pumping speeds of fore and fine pumps. "Vacuum constancy" is defined as the highest permissible total pressure on the discharge side of a diffusion pump at which the fine pressure does not rise above 10^{-4} mm Hg. Gauges are critically surveyed and the use of the alphatron and of the mass spectrometer for leak finding are discussed. Modern applications of high-vacuum plant are dealt with briefly. R. N.

533.56 : 621.527.8

1741. The design of molecular vacuum pumps. RISCH, R. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 278–85 (*Sept.*, 1948) *In German.*—The number of molecules/sec pumped by a molecular pump with a cylindrical rotor is calculated. The true number is given by $Z=Z_1-(Z_2+Z_3+Z_4)$ where Z_1 is the total number, which would flow through the spiral stator grooves if there were no counter-pressure; Z_2 the amount which would flow back with a stationary rotor under the influence of the counter-pressure and Z_3, Z_4 are the gap losses, Z_3 being due to the pressure difference between adjacent windings of the groove and Z_4 to those molecules of the gap which are carried along by the movement of the rotor. R. N.

533.59

1742. On the measurement of gaseous displacements under low pressure. DUNOYER, J.-M. *Le Vide*, **3**, 442–8 (*May*, 1948) *In French.*—Gaseous displacement at low pressure may be measured in closed or open circuit. The author uses the latter and adjusts admission by passing gas through a heated metallic membrane. Pumping speed is regulated by interposing tubes of various sizes. G. W.

533.6.01

1743. The representation of aerodynamic derivatives. TEMPLE, G. *Aero. Res. Counc.* (*Min. of Supply*) (*Rep. Mem. No.* 2114) 12 *pp.* (*March*, 1945).—This note summarizes the present knowledge of the various mathematical representations of aerodynamic derivatives and of the solutions of the equations of motion,

as illustrated by the two-dimensional theory of a plane aerofoil. The following problems are considered: the response to an arbitrary disturbance, a sudden impulse, periodic motion, divergent motion; Bryan's stability derivatives, Duncan and Collar's flutter derivatives; the representation of the aerofoil co-ordinates and of the lift and moment by infinite series; the operational representation of the aerodynamic forces and the operational solution of the equations of motion. A.

533.6.011 3/.6

1744. On the flow of gases through uniform gratings. ACKERET, J. AND ROTT, N. *Schweiz. Bauztg.*, **67**, 40–1 (*Jan.* 15); 58–61 (*Jan.* 22, 1949) *In German.*—The equations connecting velocity of gas and cross-section of a grating aperture are stated and then put into approximate forms applicable to the actual experimental conditions. The measurements taken include values of the pressure and velocity distributions in front of and behind the grating, and also resistance values. Calculated and measured values of resistance and of Mach numbers are in good agreement; and results are fully illustrated by graphs. A critical discussion is given of the experimental results, and it is concluded that resistance increase depends much less on friction than on unsymmetrical pressure distribution. Schlieren photographs are shown to correspond (*a*) with the first establishment of the velocity of sound at the narrowest section, and (*b*) with maximum resistance conditions when inclined ridges of increased density are seen in the supersonic region behind the grating. G. G.

533.6.011.4

1745. Erratum: Interferometric studies of faster-than-sound phenomena. I. The gas flow around various objects in a free, homogeneous, supersonic air stream. LADENBURG, R., WINCKLER, J. AND VAN VOORHIS, C. C. Letter in *Phys. Rev.*, **74**, 1884 (*Dec.* 15, 1948).—Correction to equation 1 of previous paper. [See Abstr. 2747 (1948)]. G. O. B.

533.6.011.5

1746. On the investigation of supersonic flow patterns by means of the shock tube. MAUTZ, C. W., GEIGER, F. W. AND EPSTEIN, H. T. Letter in *Phys. Rev.*, **74**, 1872–3 (*Dec.* 15, 1948).—The investigations described include: velocity measurements to determine shock strength as defined; the taking of shadowgraphs at predetermined times during the passage of the shock through the test section; the taking of photographs with He, air and other gases in the compression chamber. A photograph in air is reproduced, with corresponding Mach number 2·42. G. G.

533.6.011.5

1747. The method of characteristics in supersonic flow. TEMPLE, G. *Aero. Res. Counc.* (*Min. of Supply*) (*Rep. Mem. No.* 2091) 17 *pp.* (*Jan.*, 1944).—This report gives an account of the Ackeret–Prandtl–Busemann method of characteristics for the graphical solution of problems of supersonic flow. The theory has been developed anew from a physical point of view so as to expose just those properties of characteristics which are required for practical application to supersonic problems. The necessary numerical tables are included. No partial differential equations are used, except to derive Bernoulli's equation. A.

533.6.013.22

1748. The role of big eddies in homogeneous turbulence. BATCHELOR, G. K. *Proc. Roy. Soc. A*, **195** (*No.* 1043) 513–32 (1948).—A small range of eddy sizes of large wavelengths play a special part in relation to decay of isotropic turbulence. To examine the associated motion a spectrum tensor is introduced which is a function of the wave-number vector k, and its value is required for small values of k. It is found that in expanding this function for small values of k, and taking account of the continuity condition, the terms of the first and second degree are constant throughout the decay. The largest eddies of the turbulence therefore remain in existence when the smaller eddies have decayed. The spectrum function introduced is suitable for the application of similarity hypotheses, and is briefly considered from this point of view. G. G.

533.6.013.22 : 532.517.4

1749. Comments on the turbulence problem. HEISENBERG, W. *Z. Naturforsch.*, **3a**, 434–7 (*Aug.–Nov.*, 1948) *In German.*—The older point of view according to which turbulence is regarded as an instability induced by friction is contrasted with that of more recent statistical theories according to which the movements of fluids, even of frictionless liquids, is always turbulent while high viscosity tends to reduce vorticity at small Reynolds numbers. The apparent contradiction between these two views is resolved and a survey of the modern statistical theories is given. H. MO.

533.6.013.22 : 533.691

1750. The flow behind a stationary shock. LIGHTHILL, M. J. *Phil. Mag.*, **40**, 214–20 (*Feb.*, 1949).—A linearized equation for steady inviscid adiabatic flow of a gas is derived, and used to analyse the bending of the bow shock on a supersonic aerofoil due to the incidence of waves from the surface. The shock strength is not assumed to be small. The waves are reflected along the characteristics. The reflection coefficient is calculated. For a thin supersonic aerofoil the entropy boundary layer due to inexact leading edge sharpness is discussed. L. S. G.

533.6.013.3

1751. Flow of a compressible fluid about a cylinder. II. Flow with circulation. CHERRY, T. M. *Proc. Roy. Soc. A*, **96** (*No.* 1044) 1–31 (1949).—The investigation is based on the fact that any solution for compressible flow is associated with a generating function which is the solution for a corresponding case of incompressible flow. This correspondence is used to determine a solution for compressible flow past a cylinder in the case where the circulation round the cylinder is not zero. It is found that the most direct generalization of the formulae for incompressible flow yields multiple-valued formulae for compressible flow. A single-valued solution is obtained for the case of flow round a slightly distorted circular cylinder by a method in which a multiple-valued solution is obtained, containing a set of constants which can be determined by means of a set of linear equations. Numerical values for transonic flow have been worked out from certain formulae obtained in a previous paper, which gives exact solutions for steady 2-dimensional flow of a compressible fluid past a cylinder. Stream-line

diagrams are given, and commented upon, for 3 of these solutions. G. G.

533.6.08 : 621.317.39 : 551.508

Portable thermistor bridge for micrometeorology. *See Abstr.* 2229

MOLECULAR THEORY OF GASES 533.7

533.7 : 539.62 : 533.16

Air friction on rapidly moving surfaces. *See Abstr.* 1734

VIBRATIONS . ACOUSTICS 534

534.01

1752. Self-oscillating Thomson systems of the third and fourth order. TEODORCHIK, K. F. *J. Tech. Phys., USSR*, **17**, 1165–70 (*Oct.*, 1947) *In Russian.*—A self-oscillating system of the 2nd order is of the Thomson type if its oscillations—at their onset as well as in the stationary state—are very nearly harmonic. This is the case if the system in all states is sufficiently near to the corresponding conservative linear 2nd-order system, having a purely harmonic solution. Similarly, the non-degenerate self-oscillating 3rd-order system is said to be Thomsonian, i.e. admits in all conditions near-harmonic solutions, if it is sufficiently near to a non-degenerate linear 3rd-order system, having one exponential and one purely harmonic particular solution. Comparison with the general form of the linear 3rd-order equation furnishes the conditions for the replacement to be permissible, which can also be decided on the Rous–Hurwitz stability conditions. It is shown that the existence of one purely harmonic solution (provided all other particular solutions are stable) in a non-degenerate 4th-order equation is possible only if the 1st, 2nd and 4th stability conditions of Rous–Hurwitz are satisfied, and the solution is on the border of the validity of the 3rd condition. This result may be generalized for a nth-order system which, likewise, will admit of one purely harmonic solution on the validity limit of the 3rd, and satisfaction of the other Rous–Hurwitz conditions. B. F. K.

534.01 : 517.947.44

On oscillators with stabilized amplitude. *See Abstr.* 1631

534.014.5 : 517.933

1753. On the van der Pol oscillator. MINORSKY, N. *C.R. Acad. Sci., Paris*, **228**, 60–1 (*Jan.* 3, 1949) *In French.*—The oscillator satisfies the equation: $\ddot{x} - \varepsilon(1 - x^2)\dot{x} + x = 0$. New variables defined by $\rho = r^2 = x^2 + \dot{x}^2 = r^2(\cos^2\theta + \sin^2\theta)$ are introduced, and solutions are obtained by successive approximation giving ρ, the energy of the oscillator, and θ, each in ascending powers of ε. These solutions enable the energy changes between the oscillator and the source of energy to be studied. They show that ρ passes through a maximum, a minimum, and a stationary value in each half-period, the other half period being identical. The approximate solutions also provide an explanation of the origin of the known asymmetrical form of the integral curve of the above equation in the neighbourhood of a stationary point, $\theta = 0$. G. G.

534.1

1754. Mechanical admittances and their applications to oscillation problems. DUNCAN, W. J. *Aero. Res. Coun.* (*Min. of Supply*) (*Rep. Mem. No.* 2000) 128 *pp.* (*March*, 1946).—Gives a connected account of the subject and contains much hitherto unpublished material. All difficult mathematics has been avoided. A.

534.1 : 517.947.44

Nodal surfaces arising in vibration problems. *See Abstr.* 1630

534.112

1755. Plane and circular motion of a string. HARRISON, H. Letter in *J. Acoust. Soc. Amer.*, **20**, 874–5 (*Nov.*, 1948).—Refers to the difficulties encountered in forcing a stretched metal (tungsten) wire to vibrate in a plane. The wire carries alternating current controllable in amplitude, frequency and phase, and lies in the transverse horizontal field of a magnet. By varying the phase of the supply amplifier (containing a non-linear element to limit amplitude of the output voltage and to control the phase) the wire could be made to vibrate in a vertical plane, or could be rendered unstable and to vibrate in a circle. The phenomena are explained in terms of auto-parametric excitation of the sort considered by the Mathieu–Hill theory. A. B. W.

534.11

1756. Bending vibrations of a linear chain. KELLNER, L. *Proc. Phys. Soc., Lond. A*, **62**, 200–2 (*March* 1, 1949).—The bending frequencies of a linear chain of n mass points have been calculated using a harmonic potential function involving forces between second neighbours. The proper boundary conditions are introduced and a general formula for the bending frequencies is derived. A.

534.11 : 536.2 : 517.946.9

Vibrating string boundary problems. *See Abstr.* 1630.

534.121.1 : 534.232

1757. Reactance of medium and acoustic radiation damping for a circular plate. BRAUMANN, H. *Z. Naturforsch.*, **3a**, 340–50 (*June*, 1948) *In German.*—The acoustic wave equations in bipolar co-ordinates are derived theoretically for the sound field produced by a circular plate vibrating in the direction of its axis with small harmonic amplitude. The medium is first considered as incompressible, and later as compressible. Formulae are derived for the power emitted by the plate at known frequency and velocity amplitude. A. B. W.

534.2 : 539.382

Dynamic acoustical properties of plastic plates. *See Abstr.* 2163

534.213 : 550.34

1758. On the analysis of a small arbitrary disturbance in a homogeneous isotropic elastic solid. PENDSE, C. G. *Phil. Mag.*, **39**, 862–7 (*Nov.*, 1948).—The equations of motion are derived and the chief

pecial types of motion are discussed. It is pointed ut that when the motion is arbitrary (i.e. neither of he 2 basic types, wholly irrotational or wholly equi-oluminal) it consists of 2 distinct parts, depending on equations similar to those for the basic types but nvolving different physical quantities. The analysis hows that in seismology there can be waves which are neither longitudinal nor transverse; conditions under which these may exist are pointed out. L. S. G.

534.213.4 : 534.373

1759. **The damping of sound waves of large amplitude in tubes.** RICHARDSON, E. G. *Proc. Math. Phys. Soc. Egypt*, **3**, 73–8 (*May*, 1947) *In English.*—Pulses of sound are produced in a brass tube by expelling a tightly fitting piston under excess pressure. These are recorded on a steel ring by means of a calibrated recorder consisting of a system of levers. The damping in dried air and CO_2 is measured. The results indicate that the damping coefficients are $\geqslant$ the Kirchhoff's values. It is shown that the damping increases with increase of pressure. No increase of velocity with increased amplitude was detectable. A. B. W.

534.22 : 536.48

Second sound and the behaviour of helium II. *See Abstr.* 1875

534.222.2 : 533.6.011.5

1760. **Theory of the bifurcated compression shock wave.** WUEST, W. *Z. angew. Math. Mech.*, **28**, 73–80, (*March*, 1948) *In German.*—A simplified graphic determination is given. The method fails when one of the waves degenerates into a Mach wave, and an analytical method is developed for that case. The conditions for the occurrence of bifurcated shock waves are discussed. A comparison between the theory and experiments is included. V. W. R.

534.23 : 532.13 : 539.62

1761. **The theory of internal friction in gases and liquids, and sound absorption.** SKUDRZYK, E. *Acta Phys. Austriaca*, **2** (*No.* 2) 148–81 (1948) *In German.*—The theories of sound attenuation due to viscosity and heat conduction, developed by Stokes and Kirchhoff, are inadequate to explain the experimental observations. Introducing the Boltzmann fundamental equation for gas theory, equations are derived for wave propagation in a viscous medium, the phase velocity and damping being derived from the complex sound velocity at a wide range of frequencies. Tables comparing the "classical" values of sound absorption in various gases and liquids with the "corrected" values are given. A. B. W.

534.23 : 534.37 : 534.321.9

1762. **Absorption and dispersion of ultrasonic waves in acetic acid.** LAMB, J., ANDREAE, J. H. AND BIRD, R. Letter in *Nature, Lond.*, **162**, 993–4 (*Dec.* 25, 1948).—A pulse technique has been used which enables the velocity of propagation and the absorption coefficient to be measured in the frequency range 0·5–9·8 Mc/s. Agreement is obtained between the experimental points and the calculated curves for the absorption, but the value obtained for the velocity dispersion observed is slightly less than the theoretical value. This is attributed to the limited accuracy of the velocity measurements. G. F. H.

534.23 : 534.321.9

1763. **Attenuation of sound in rarefied helium.** GREENSPAN, M. Letter in *Phys. Rev.*, **75**, 197–8 (*Jan.* 1, 1949).—The attenuation of sound at 1 Mc/s in He, at pressures ranging from 30 to 0·4 mm Hg, has been measured in an attempt to elucidate mean-free-path effects. At the lowest pressure reached the wavelength (about 1 mm) was 2 or 3 mean-free-paths. The measured values of attenuation are shown to be in substantial agreement with classical hydrodynamic value down to the lowest pressures employed. A. B. W.

534.23 : 534.321.9 : 532.74

1764. **A theory of ultrasonic absorption in unassociated liquids.** BAUER, E. *Proc. Phys. Soc., Lond. A*, **62**, 141–53 (*March* 1, 1949).—In many liquids the absorption of sound waves is $\geqslant$ can be explained classically, in terms of viscosity and heat conduction. Different types of liquids behave differently in this respect, the cause of the excess absorption in unassociated, polyatomic liquids like C_6H_6 and CS_2 lies in the incomplete excitation, by the sound wave, of the vibrational degrees of freedom. It is shown that this effect leads to mean dispersion frequencies in the range 10^9 to 10^{10} c/s at 300°K. This frequency range shows that, as in the case of gases, the efficiency of collisions in producing excitation or de-excitation of vibrational degrees of freedom is fairly low; a theoretical treatment of this effect is outlined. Detailed considerations of temp. coeffs. of absorption lead to the conclusion that all the vibrational levels of a liquid do not relax at the same frequency but that high excited levels relax at relatively low frequencies. In the case of CS_2 a numerical estimate of these individual dispersion frequencies is made. It is also shown that the variation of absorption with concentration in binary mixtures can be described in terms of this analysis. A.

534.23 : 534.845

1765. **Transmission of sound through air at low pressure.** LINDSAY, R. B. *Amer. J. Phys.*, **16**, 371–7 (*Oct.*, 1948).—The problem is treated in terms of relaxation dissipation. Consideration is given to (1) wave propagation with relaxation dissipation; (2) viscosity and heat-conduction dissipation; (3) classical approximation for very high frequency. Experiments are described in which transmission loss is measured in a low-pressure tank, at 384–6 950 c/s. Over the pressure (atmospheric to 5 mm of Hg) and frequency ranges employed, the absorption due to viscosity and heat conduction is negligible (in agreement with the theory). The pressure tank measurements indicate increasing impedance mismatch (transmitter—medium—receiver) with decreasing pressure. A. B. W.

534.231.3 : 534.845

1766. **Acoustic parameters for absorbing substances in the form of grains.** FERRERO, M. AND SACERDOTE, G. *Nuovo Cim.*, **5**, 551–66 (*Dec.*, 1948) *In Italian.*—Experiments were performed to determine the acoustic impedance of lead pellets and various sands. Results are generally in agreement with existing theories, except for values of the inductance. L. P.

534.232

1767. Remarks on measurement of electromotive force of a microphone. COOK, R. K. Letter in *J. Acoust. Soc. Amer.*, **20**, 874 (*Nov.*, 1948).

534.3 : 534.862.2 : 786

1768. On the performance of cup mouthpiece instruments. LONG, T. H. Letter in *J. Acoust. Soc. Amer.*, **20**, 875–6 (*Nov.*, 1948).—A reply to a number of questions raised by Young relative to a previous paper by the author [see Abstr. 3663, 879 (1948)]. A. B. W.

534.321.9 : 531.717.1

Portable ultrasonic thickness gauge. *See Abstr.* 1709

534.321.9 : 534.844

1769. Ultrasonic reverberation measurements in liquids. MULDERS, C. E. *Appl. Sci. Res.*, **B 1** (*No.* 3) 149–66 (1948) *In English.*—A description of an apparatus for the measurement of the reverberation time of ultrasonic waves in a vessel filled with a liquid. This time depends upon the absorption of the waves by the liquid, the walls of the vessel and several other causes. A method to separate experimentally these different causes of absorption is discussed in detail. It is used to determine the ultrasonic absorption in H_2O at frequencies $\simeq 1$ Mc/s. Only 2–3 litres of liquid is needed for the determination. Absorptions as small as 0·1 db/m can be measured with reasonable accuracy. A.

534.321.9 : 620.179.16

1770. Material-testing by an ultrasonic method. POHLMAN, R. *Technik*, **3**, 465–70 (*Nov.*, 1948) *In German.*—A beam of ultrasonic waves is sent through the material under test and the emergent beam is focused by means of an acoustic lens on to an image convertor of special design which renders visible the differences in absorption suffered by the beam. Commercial equipment for use in detecting small defects such as air inclusions 10^{-4} mm and less in thickness, in examining metal plates of large size (image field 50 cm in dia.) and in production checking is described and some typical results illustrated in photographs. H. J. H. S.

534.414

1771. Coupled solid and cavity acoustic resonators [Tonpilze und Tonräume]. FISCHER, F. A. *Frequenz*, **2**, 232–9 (*Sept.*, 1948) *In German.*—The simplest type of mechanically oscillating system (spring and mass), the "Tonpilz" of Hahnemann and Hecht, and its electrical analogue (condenser and inductance) form the basis of the discussion. This simple treatment is extended to two mechanical oscillating systems coupled together—a double Tonpilz—as in the well-known Hahnemann and Hecht oscillators. Similar considerations are applied to the coupling of two Helmholz air cavity resonators. A. B. W.

534.414

1772. The absorption coefficient of resonators. SACERDOTE, G. G. *Alta Frequenza*, **17**, 217–19 (*Oct.*, 1948) *In Italian.*—Measurements of the variation with frequency of the reverberation time of a chamber containing a large number of similar resonators show that the curve has maxima corresponding to the resonant frequencies of the resonators. T. S. E. T.

534.441.1/.2 : 534.1

1773. A photoelectric type of acoustic spectrograp using sound film. BROWN, D., COLEMAN, C. F. AN LYTTLETON, J. W. *Proc. Phys. Soc., Lond. B*, 6 149–62 (*March*, 1949).—An account is given of a apparatus which analyses non-recurrent waveforn such as occur in speech, so that frequency-distributio is represented against time in an *FT*-diagram. Fro the theory governing such diagrams, no uniqu representation is possible, the result depending on th analysing convention adopted, but all conventio are governed by the uncertainty relation $\Delta F \Delta T \geqslant$ The method employed is an optical one which analyse a continuously moving sound film by means of frequency-scanning disc, so producing an oscillograp pattern which is photographed on to another movin film. Typical analyses are reproduced and discusse mainly "speech patterns" which show the compositio very clearly. Advantages include the ability to reco the amplitude and phase of each component, also th ability to change the analysing convention in an desired manner, for example to give the error-functio convention which leads to minimum uncertaint The paper concludes with considerations of resolvin power, spectral line profiles, and amplifier ban width requirements.

534.

1774. A bridge for measuring acoustic impedanc MOKHTAR, M. *Proc. Math. Phys. Soc. Egypt*, 65–71 (*May*, 1945) *In English.*—An acoustic equivale of the a.c. Wheatstone bridge has been developed f measuring reactances of acoustic units. The sou source is a loudspeaker unit and details are given a differential condenser microphone which is used a detector. Measurements made on reactances who value can be computed theoretically indicate a error of 3%. The bridge may have possible applic tions to the measurement of impedances of horns an acoustic filters and also to measurements of th reflection coefficients of acoustic materials. G. F.

534.

1775. Concert-hall acoustics. PARKIN, P. H *Nature, Lond.*, **163**, 122–4 (*Jan.* 22, 1949).—A repo of a discussion organized by the Physical Socie (Acoustics Group) to bring together musician architects, engineers and scientists, for a gener discussion, with particular reference to the ne concert halls for London. Outlining progress in th development of concert halls from the 18th centu to date, Hope Bagenal states the two main requir ments of a good concert hall to be "definition" an "singing tone." Numerous musicians and architec took part in the ensuing discussion. A. B. V

534.845

1776. A simple arrangement for measuring sou absorption at low frequencies. BEKKERING, D. H. AN KOSTEN, C. W. *Appl. Sci. Res.*, **B 1** (*No.* 3) 205–1 (1948) *In English.*—In a preceding paper [Abstr. 9 (1948)] Kosten described the relation between th electrical behaviour of a loudspeaker, movable in tube which is closed at the side opposite the lou speaker by an acoustical sample, and the acoustic absorption coefficient a of the sample. The arrang ment described makes it possible to determine th

coefficient according to the aforesaid relation by means of some voltmeter readings. A.

534.851 : 681.84

1777. The design of a balanced-armature cutter-head for lateral-cut disc recording. WILLIAMS, F. E. *Proc. Instn Elect. Engrs, Pt III*, **96**, 145–58 (*March*, 1949).—Principles of design of a recording head, including both the elementary theory of the vibratory system and the design of the electromagnetic system, are given. The design of a balanced-armature type of unit is examined, and it is shown that there is no simple method of calculating the optimum values for the dimensions of the moving parts, since there are a number of variables, each one of which affects the optimum values of all the others. The causes of non-linear distortion are analysed, and it is shown that, by making certain approximations, it is possible to calculate the effect of the relative dimensions of the various parts of the system on distortion. As a practical example, the design and performance of a recording head are discussed. The limitations set by the magnetic circuit make it impracticable to obtain modulation velocities of the order of 15 cm/s at 400 c/s unless the fundamental resonant frequency of the mechanical system is made $< 3\,000$ c/s. A.

534.852 : 621.395.625.3 : 621.3.013.2 : 681.84

1778. Magnetic field distribution of a ring recording head. BEGUN, S. J. *Audio Eng.*, **32**, 11–13, 39 (*Dec.*, 1948).—A graphical analysis is made of the magnetic field to which successive layers of the recording medium parallel to the pole surface are subjected. It is shown that at the centre of the gap the longitudinal components of the induction for layers close to the pole faces are almost four times greater than for the deepest layers, also that the effect of the perpendicular component is much more pronounced in layers adjacent to the pole face. Experience has shown that a.c. biasing of the field must be of a certain magnitude to assure a linear transfer characteristic and the analysis indicates that underbiasing is less harmful than overbiasing. The variation of magnetization in nearby and distant layers of the recording medium and its effect at higher frequencies are discussed. No account is taken of the effect of change of direction of the magnetizing force or of demagnetizing effects. B. B. A.

534.86

1779. Synthetic sound on film. LEWIS, R. E. AND MCLAREN, N. *J. Soc. Mot. Pict. Engrs*, **50**, 233–47 (*March*, 1948).—An analysis of both hand-drawn and machine-made sound tracks is presented together with methods. Synthetic sound tracks for the first time enable a composer to hear his composition as written rather than through artists' interpretation. Three basic methods are presented: (1) hand drawing directly on the film, (2) frame-by-frame photography of drawings and patterns, and (3) mechanical generation by machines, such as the harmonic integraph, which are coupled to a variable-area or -density modulator registering on the film. A.

534.88

1780. Sofar. STIFLER, W. W., JR. AND SAARS, W. F. *Electronics*, **21**, 98–101 (*June*, 1948).—SOund Fixing And Ranging is a position-finding system for air-sea rescue. The survivors release a $\frac{1}{4}$ lb bomb set to explode at a depth of $\sim \frac{3}{4}$ mile and produce a sound wave which is restricted to the horizontal plane owing to refraction arising from temperature and pressure gradients. Hence the wave can be picked up at distances up to 2 000 miles and fixed by 3 or more stations to within 5 miles. The recording equipment, which is fully described, is permanently in operation, includes time indexing and is semi-automatic. H. G. M. S.

OPTICS . RADIATION . SPECTRA 535

535.14 : 530.145

Radiation damping of an oscillator. *See Abstr.* 1691

535.2.08 : 545.82

1781. An infra-red chopped-radiation analyzer. KIVENSON, G., STEINBACK, R. T. AND RIDER, M. *J. Opt. Soc. Amer.*, **38**, 1086–91 (*Dec.*, 1948).—A design is presented for a double-beam i.r. analyser that utilizes the chopped-light principle. The advantages are low rate of drift at high sensitivities, freedom from the effects of ambient temperatures, and general ruggedness, all of which make the system adaptable to plant analytical and control problems. The receiving system consists of a thermistor bolometer and tuned amplifier. Performance data are given for the butadiene recycle impurity system of a GR–S synthetic rubber plant stream. A.

535.214 : 538.566.5

Radiation pressure of centimetre waves. *See Abstr.* 2032

535.215 : 621.383

1782. Photoelectric cells: A review of progress with special reference to use in photometry and radiometry. PRESTON, J. S. *Rev. Opt. (Théor. Instrum.)* **27**, 513–37 (*Aug.–Sept.*, 1948) *In French.*

535.23.08 : 537.312.62

1783. The effect of current magnitude upon the behavior of a superconducting bolometer in its transition region. FUSON, N. *J. Appl. Phys.*, **20**, 59–66 (*Jan.*, 1949).—A simple theoretical analysis is shown to be useful in predicting phenomena such as the shape of the transition curve and the dependence of the bolometer time constant upon the current magnitude. The analysis holds for currents smaller than a critical value which is equal to the square root of the ratio of the bolometer cooling constant to its dR/dT (R = resistance). This critical current value is 15–30 mA. Qualitative extension of the theory to the case of large currents is made by considering the presence of regions at different temperature within the bolometer and by summarizing the possible effects of the magnetic field due to the current upon the transition. Experimentally obtained transition curves are given for both small and large bolometer currents. A.

535.233.5 : 536.52

1784. Difficulties in the determination of the true temperature of tungsten. BRINKMAN, H., RUTGERS, G. A. W. AND DE VOS, J. C. *Rev. Opt. (Théor. Instrum.)* **27**, 426–30 (*July*, 1948) *In French.*—Measurements of emission in 100 Å bands from a W ribbon held at various temperatures were used with

Hamaker's data on the emissive power of W to calculate values of the true temperature. Two sets of values thus derived, from the emission at 5 600 and 6 500 Å respectively, agreed up to 1 600°K but then diverged to the extent of 21° at 2 700°K. Other results on emissive power of W are reviewed. More accurate emission data are required, taking into account the physical state of the W and the conditions under which it is used. S. T. H.

535.241

1785. Photometric nomenclature in the post-war world. Moon, P. and Spencer, D. E. *Bull. Soc. Franç. Élect.*, **8**, 466–74 (*Oct.*, 1948) *In French.*—A translation of a paper first published in *Illum. Engng*, **42**, 611 (*June*, 1947), and reiterating, with some additions, the authors' new system of photometric nomenclature [see Abstr. 1170 (1947)]. J. W. T. W.

535.243 : 545.82

1786. New "offset" method of interpreting spectrophotometric curves. Shurcliff, W. A. and Stearns, E. I. *J. Opt. Soc. Amer.*, **39**, 72–5 (*Jan.*, 1949).—Qualitative and quantitative analyses of light-absorbing solutes may be carried out rapidly and accurately by direct visual comparison of "offset" spectrophotometric curves linear in log log $1/T$ and plotted on transparent paper. Only the final chemical analytical data are read; no explicit account is taken of optical parameters, and the curves may be plotted on gridless paper. A.

535.245.22

1787. Light-flux determination with planimeter. Meyer, E. *Arch. tech. Messen* (*Issue No.* 157) *Ref. V*424-2, *T*102 (*Oct.*, 1948) *In German.*—Describes a specially constructed diagram for plotting the candle-power distribution from a lamp or fitting. The c.p. scale varies with the angle, being proportional to $\sqrt{(I \sin\theta)}$ where I is the c.p. at an angle θ with the vertical; consequently the area of the distribution curve is proportional to the luminous flux.

J. W. T. W.

535.247.4 : 535.61–31

1788. An ultraviolet photometer. Harvey, R. B. *Canad. J. Res. F*, **26**, 441–6 (*Oct.*, 1948).—Describes a photoelectric photometer for measuring the transmission of a solution in the near ultraviolet. The maximum sensitivity of the photocell used is at 3 800 Å and the source of light is an argon lamp.

J. W. T. W.

535.247.4 : 535.361.2

1789. Gloss measurement of papers: a comparative study. Harrison, V. G. W. *J. Sci. Instrum. Phys. Ind.*, **26**, 84–90 (*March*, 1949).—The performance of the Bausch and Lomb and Sheen glossmeters is examined. Comparison of gradings of 9 printing papers according to visual and instrumental means shows that, despite high correlation between them, there are important discrepancies not attributable to sampling, instrumental or personal errors. The effect of angle of incidence and viewing on grading is investigated; best results are noted at 45°, and the discrepancies become more pronounced at greater angles. Gradings of the same papers according to the Jones, Askania, Goerz, Ostwald and Klughardt methods are examined; all are found unsatisfactory. A.

535.249 : 535.89

1790. On the radiation from transient light sources. Booth, F. *Proc. Phys. Soc., Lond. A*, **62**, 95–113 (*Feb.* 1, 1949).—A theoretical treatment is given of the problem of analysing the radiation from transient light sources in the form of clouds of incandescent particles. A method of correlating this radiation with various physical parameters has been suggested by Caldin; a critical examination of this method is made, and exact formulae derived for special models. Expressions for the radiation emitted by a cloud of incandescent particles, all at the same temperature, are obtained for: (i) a uniform spherical distribution of equal, perfectly emitting and absorbing particles; (ii) a uniform distribution of particles which are not perfect absorbers, but in which (*a*) radiation is reflected specularly from the particle surface, and (*b*) the particles reflect light diffusely; (iii) a uniform distribution of particles in a thin spherical shell. It is shown that the condition for the radiation from a cloud of black-body particles to be equal in intensity to that from a black body of the same size and shape is that $R^2 a \rho_0 \ll M$, where R is the radius of the cloud, a the particle radius, ρ_0 the particle density and M the total mass of the cloud. The cooling of clouds by radiation transfer is also examined theoretically. The bearing of the results on Caldin's method is discussed, and more exact methods of analysing the cooling of this form of light source sketched. A.

535.317.1 : 535.81

1791. Reflected light and ghosts in optical systems. Murray, A. E. *J. Opt. Soc. Amer.*, **39**, 30–5 (*Jan.*, 1949).—Each surface in an optical system reflects a small fraction of the incident flux, which thus is lost to the image; these surfaces singly and in combination form ghost images of the light source, in various locations in and about the system. The number of first-order ghosts is equal to the number of surfaces, and the number of second-order ghosts equals the number of pairs of surfaces. The total flux through the ghosts is shown to be $F_0\rho(1 - t^{2n})/1 - t^2$ for first-order ghosts, and

$$\rho^2 t^n \sum_2^n (i-1) t^{2(n-i)} = \frac{\rho^2 t^n}{1-t^2}\left[n - \frac{1-t^{2n}}{1-t^2}\right]$$

for the double-reflection second-order ghosts, where n is the number of surfaces at which reflection can take place, t the transmittance, and ρ the reflectance at each surface. In the general case of s inter-reflections, $1 < s \leqslant n$, combinational theory indicates an expression:

$$\frac{n!}{(n-2)!2!} + 2\frac{n!}{(n-3)!3!} + 3\frac{n!}{(n-4)!4!} + \cdots + (s-1)\frac{n!}{(n-s)!s!}$$

for the number of ghosts, since (*a*) inter-reflection potentially can happen an unlimited number of times in any group, so that all multiplets of order less than s must be included, and (*b*) first reflection is prohibited at the first surface in all multiplets, because of the direction of light flow. The relations are applied to a system of triplet condensers and projection lenses, coated and uncoated in all combinations.

Even though the ghost flux is minimum in the condenser-unfilmed, objective-filmed objective, it offers no advantages over the all-filmed case, because of the lower transmission. A.

535.317.5/.6

1792. General properties of feeble aberrations. Application to coma and to the calculation of certain aberrations of eccentricity. MARÉCHAL, A. *Rev. Opt.* (*Théor. Instrum.*) **27**, 649–56 (*Nov.*, 1948) *In French.*—Some general properties of feeble aberrations are established with a view to demonstrating certain points of geom. optics, and the results are applied to coma calculations. In particular the case is considered where the instrument aperture in the image space is considerable and the optical system is affected by residual spherical aberration. Eventually a case of coma due to eccentricity is studied. A.

535.32

1793. The refractivity of aliphatic sulfides. MATIAS, S. *An. Acad. Brasil. Ciênc.*, **20**, 287–307 (*Sept.*, 1948) *In English.*—An attempt is made to calculate the most probable value for the atomic refractivity of S in aliphatic sulphides. No new experimental work is described, the whole of the calculations being based on published data. An examination is also made of the influence of molecular structure on refractivity. A. H.

535.327 : 548.0 : 537.226

1794. The temperature dependency of the index of refraction of heteropolar solids. VAN SANTEN, J. H. AND JONKER, G. H. *Philips Res. Rep.*, **3**, 371–7 (*Oct.*, 1948).—While the electronic polarizability of molecules does not vary much with temperature, that of heteropolar lattices shows a pronounced temperature dependency. It is suggested that this is because it is mainly of an electron-transfer type. A.

535.33 : 535.61–15

1795. Recent development in the technique of infra-red spectroscopy with some applications to scientific and industrial problems. SUTHERLAND, G. B. B. M. *Trans. Instrum. Meas. Conf. Stockholm* (1947) (*Norrköpings Tidningars Aktiebolag*) 5–16. *In English.*—Ideally an i.r. spectrometer should cover a wavelength of 2·5–100 μ; in practice the upper limit is restricted to 25 μ, and even so the practical problems are considerable. Detectors must have fast response and high sensitivity in order to maintain resolution. Selective detectors are useful over a limited spectral region but non-selective detectors, the thermocouple, bolometers, Golay cells, etc., may be used over the whole band. A reasonably satisfactory thermocouple is available but the superconducting bolometer is more rapid and sensitive although awkward in use and not readily available. A practical possibility is the thermistor bolometer, much faster than a thermocouple and slightly more sensitive. The PbS photoconductive cell is a most important selective detector (1–3 μ) and is the most rapid yet discovered. Spectrometer design has improved considerably in recent years, excellent automatic recording prism instruments being available. A range of 6 prism materials will cover 2·5–28 μ, the rock-salt prism being a general-purpose one. Double (split) beam and c.r. presentation are two recent advances, the first enabling the detection of weak bands and the second giving a notable time saving in that a complete spectrum can be displayed in a fraction of a minute. Others are the use of a chopped radiation beam, methods of plotting the spectra, and use of a grating to improve resolving power. A new method of i.r. analysis needs no spectrometer, being virtually a method of i.r. filter photometry and is applicable to routine industrial analysis. E. D. H.

535.33.07–15

1796. Spectroscopic apparatus for the infra-red. PUCCIANTI, L. *Nuovo Cim.*, **5**, 37–43 (*April*, 1948) *In Italian.*—Describes in detail an infrared spectrometer in which the various optical elements are mounted with the radiometer on a solid base plate carried on a masonry pillar in a room with thick walls and small windows to avoid excessive variations of ambient temperature. J. W. T. W.

535.33.07–15 : 522.615

A solar infra-red reflecting spectrometer. *See Abstr.* 1642

535.33.072

1797. Direct recording of spectra in the region 1·2 μ to 3 μ using the lead sulfide photo-conductive cell. NELSON, R. C. *J. Opt. Soc. Amer.*, **39**, 68–71 (*Jan.*, 1949).—The problems arising in the use of the PbS cell for direct recording of spectra are investigated using a spectrograph designed especially for this work. The inhomogeneity of the surface of these cells, as compared with photo-multipliers, makes for important differences in their use. Using a sharply tuned amplifier, the sensitivity of the cells at room temperature is adequate to permit a resolving power of $\sim$40 000 at 1·4 μ. Wavelengths may be determined to about 0·1 Å. A.

535.33.072–15

1798. Infra-red spectrometer recording system. HOVORKA, J. AND DUNLAP, E. A., JR. Note in *Rev. Sci. Instrum.*, **19**, 915–16 (*Dec.*, 1948).—The system comprises a galvanometer/double-photocell amplifier followed by the recorder (Brown strip-chart) amplifier with negative feedback to the thermopile-detector circuit of a voltage obtained from a potentiometer rigidly connected to the recording pen. Linearity depends on the potentiometer slide-wire, while condenser feedback reduces the galvanometer time constant. D. H. W.

535.33.072–15 : 535.825

Infra-red microscopy with the reflecting microscope. *See Abstr.* 1854

535.33.072.093–15

1799. Elimination of water vapor in infra-red spectrometers. GIGUÈRE, P. A. AND BADGER, R. M. Letter in *J. Opt. Soc. Amer.*, **38**, 987–8 (*Nov.*, 1948).—Damp air is displaced by a stream of "dry" N_2 from a cylinder. D. H. W.

535.331

1800. High members of the principal series in caesium. MCNALLY, J. R., MOLNAR, J. P., HITCHCOCK, W. J. AND OLIVER, N. F. *J. Opt. Soc. Amer.*, **39**, 57–8 (*Jan.*, 1949).—Summary of results of an investigation begun several years ago. The more intense doublet member of the principal series of Cs in absorption is recorded to the 62nd quantum state, whereas the weaker doublet member is recorded to the

14th quantum state only. An empirical formula fitting the longer series to about $\pm 0{\cdot}03$ cm^{-1} is given. The calculated series limit of 31 406·32 cm^{-1} corresponds to an ionization potential of 3·8929 V for the Cs atom. A.

535.333 : 537.525

1801. Spectroscopic study of the initial discharge in nitrogen, oxygen and air. BERNARD, R. AND PEYRON, M. *C.R. Acad. Sci., Paris*, **227**, 1086–8 (*Nov.* 22, 1948) *In French.*—Anomalous intensities, especially in the first positive system of N_2, are reported. R. F. B.

535.333 : 539.13

1802. The emission spectrum of sodium hydride. PANKHURST, R. C. *Proc. Phys. Soc., Lond. A*, **62**, 191–9 (*March* 1, 1949).—Observations on the spectrum of NaH have been extended to longer wavelengths (4 600–6 450 Å) and photographed under high dispersion. Analysis of the data thus obtained gives values of the vibrational and rotational constants for several new vibrational levels, among which the lowest levels of the excited state are of especial interest. The intensity distribution has been calculated from the wave functions appropriate to potential energy curves based on the constants derived from the analysis of the band system. The theoretical estimates are found to be in fair agreement with the experimental results. A.

535.333 : 539.133 : 539.155.2

1803. Some preliminary results on the spectra of AsH_3, AsD_3 and PH_3. MCCONAGHIE, V. M. AND NIELSEN, H. H. *Proc. Nat. Acad. Sci., Wash.*, **34**, 455–64 (*Sept.* 15, 1948).—The results of rotational analyses of the bands ν_1 of AsH_3 and AsD_3 and ν_2 of AsH_3 are reported, and an account is given of preliminary work on absorption regions attributed to ν_3 and ν_4, $2\nu_1$ and $2\nu_2$, for AsH_3 and AsD_3, and $2\nu_3$ and $2\nu_4$ for AsH_3. The band-centres, ν, and normal frequencies, ω, are as follows:

	ν_1	ν_2	ν_3	ν_4	ω_2	ω_4
AsH_3	2116·1	2123·0	904·4 906·9	1003	2225·8	1012·1
AsD_3	1523·1	1529·3	660	714	1528·4	718·6

The As-H or As-D distance is 1·513 Å, the height of the pyramid 0·93 Å, and the angle between a bond and the axis of symmetry $\sim 54°30'$. For PH_3, examination of the region near 4·3 μ suggests that bands ν_1 and ν_2 are involved. Analysis of ν_1-lines leads to a band-centre at 2 322·9 cm^{-1} and to $B'' = 4{\cdot}358$, $B' = 4{\cdot}301$. The band-centre for ν_2 is estimated at 2 328 cm^{-1}. Examination of the region near 10 μ leads to estimates of the centres ν_3 at 990 and ν_4 at 1 121 cm^{-1}. Coriolis interaction between ν_3 and ν_4 is observed both for PH_3 and for AsH_3. R. F. B.

535.337 : 537.527

1804. New spectra of van der Waals molecules observed in compressed helium. WENIGER, C. AND HERMAN, L. *C.R. Acad. Sci., Paris*, **227**, 1022–4 (*Nov.* 15, 1948) *In French.*—Visible spectra excited by a discharge in He at 90 kg/cm^2 are described: diffuse bands are attributed to He_2 and HeO complexes.

R. F. B.

535.338

1805. Multiplet separations in complex spectra. III. RAO, V. R. *Indian J. Phys.*, **22**, 423–7 (*Sept.*, 1948).—The separation factors have been calculated for multiplet-terms arising out of equivalent electron configurations of the type f^1 and f^2. [See Abstr. 3677 (1948)]. A.

535.338 : 551.594.22

1806. On the Schumann–Runge O_2 bands emitted at atmospheric pressure. FEAST, M. W. *Proc. Phys. Soc., Lond. A*, **62**, 114–19 (*Feb.* 1, 1949).—The Schumann–Runge bands of O_2 have been obtained from 2 000 Å to 5 000 Å on sufficient dispersion for the vibrational analysis to be extended and for the rotational structure to be clearly resolved. Conditions for their emission are discussed and the probable process, involving dissociation followed by recombination, is outlined. On this basis the results obtained in discharges, ozonizers and high-voltage arcs are explained. Flory's suggestion of predissociation in the upper state is reviewed and the experimental evidence found to be against it. The conclusions reached are applied to considerations regarding the spectrum of the night sky. A.

535.338 : 551.593.9

Spectrum of molecular He in night sky radiation. *See Abstr.* 2255

535.338 : 551.594.22

1807. The spectrum of lightning. NICOLET, M. *Inst. Roy. Met. Belge Misc.* (*No.* 10) 3–10 (1942) *In French.*—Early observations are briefly reviewed and line identifications are tabulated for the prominent features within the spectral range 3 830 Å to 5 000 Å. These are due principally to excited neutral and ionized atoms of N and O. D. R. B.

535.338 : 551.594.5

1808. The green auroral line as an initiator of phosphorescence in condensed systems. VEGARD, L. AND KVIFTE, G. Letter in *Nature, Lond.*, **162**, 967–8 (*Dec.* 18, 1948).—Spectrograms of a Tesla discharge in samples of purified A containing minute traces of O show the green auroral line (5 577 Å) asymmetrically placed on a band of continuum about 185 Å wide. The line itself is diffuse. Samples containing higher concentrations of O do not exhibit the phenomenon, which is considered similar to that described by Vegard (1924) when attempting to identify the auroral line at 5 577 Å with an emission feature obtained by cathode-ray excitation of mixtures of solidified N and inert gas. The necessary condition for the appearance of the green phosphorescent band is an extremely low concentration of O in the gaseous discharge channel. No similar band structure has been observed as yet in association with the red O I doublet at 6 300–60 Å. D. R. B.

535.338.332

1809. Rotational structure of λ3600–λ3200 Å bands of Na_2. SINHA, S. P. *Indian J. Phys.*, **22**, 401–8 (*Sept.*, 1948).—The λ3432 Å (2, 3), λ3450 Å (2, 4) and λ3468 Å (2, 5) bands of the λ3600–λ3200 Å system of Na_2 have been photographed in the first order of a 21 ft concave grating with a dispersion of $\simeq 1{\cdot}3$ Å/mm and an attempt has been made to study their rotational structure. Each band is found to consist of a single P and a single R branch, characteristic of a $^1\Sigma - {}^1\Sigma$ transition. The lower state is known to be a $^1\Sigma_g^+$ state due to $3\,^2S + 3\,^2S$ atoms of sodium. Hence the upper state will be of $^1\Sigma^+$ type and is considered,

from the results of vibrational analysis, to be due to $3\,^2S + 3\,^2D$ or $3\,^2S + 4\,^2P$ atoms. The values of the molecular constants obtained are: $B_3'' = 0{\cdot}152\ cm^{-1}$, $B_4'' = 0{\cdot}151\ cm^{-1}$, $B_5'' = 0{\cdot}151\ cm^{-1}$, $B_e' = 0{\cdot}103\ cm^{-1}$ and $r_e' = 3{\cdot}7_7$ Å. It has not been possible to evaluate α and D from the present data. A.

535.338.332

1810. Structure of the ^2D terms of the arc spectrum of lithium. MEISSNER, K. W., MUNDIE, L. G. AND STELSON, P. H. *Phys. Rev.*, **74**, 932–8 (*Oct.* 15, 1948).—Interferometric wavelength measurements of high precision carried out by employing an atomic beam light source have been used for the study of several features of the arc spectrum of Li^7. Due to the great sharpness of the spectral lines produced by this source it was possible to determine the splitting of several ^2D terms. The hyperfine structure of the line 6 708 Å was found in approximate agreement with earlier investigations. Precise wavelength measurements have been carried out relative to Kr standards. Discrepancies between the wavelengths of this investigation and those of earlier investigators must be ascribed to lack of resolution or inadequate comparison methods employed in earlier investigations. This consideration is substantiated by measurements carried out with a vacuum Li arc, the results of which are consistent with the atomic beam values. Isotopic shift (Li^6 and Li^7) of the resonance line 6 708 Å was measured. A.

535.338.4

1811. Relative transition probabilities of the Swan bands of carbon. KING, R. B. *Astrophys. J.*, **108**, 429–33 (*Nov.*, 1948).—The relative transition probabilities for the vibrational structure of the Swan band system of C_2 have been derived from relative intensities of the band heads appearing in the emission spectrum from a graphite-tube electric furnace. The method and possible sources of error are discussed. Self-reversal effects are shown, by examination of the absorption spectrum, to be negligible. The results are compared with those of Johnson and Tawde and with theoretically derived values, discrepancies from which are probably real. A. G. G.

535.338.4

1812. The CN tail bands emitted by the carbon arc in air. FEAST, M. W. *Proc. Phys. Soc., Lond. A*, **62**, 121–2 (*Feb.*, 1949).—Wavelengths and intensities of 21 CN tail bands, observed in the carbon arc spectrum, are listed and quantum numbers assigned. 9 of the bands have been previously reported as occurring in the N afterglow excitation. The intensities of the tail bands are shown to be in accordance with the accepted potential curves for this system. A.

535.338.4

1813. Ultra-violet bands of Na_2. SINHA, S. P. *Proc. Phys. Soc., Lond. A*, **62**, 124–30 (*Feb.* 1, 1949).—The u.v. bands of Na_2 between 3 600 Å and 3 200 Å have been photographed in absorption in the first order of a 21 ft concave grating with a dispersion $\sim 1{\cdot}3$ Å/mm and their vibrational analysis carried out. All the bands belong to a single system and can be represented by the equation: $\nu = 29\,342 + 119{\cdot}33(u') - 0{\cdot}53(u')^2 - 159{\cdot}23(u'') + 0{\cdot}726(u''^2)^2 + 0{\cdot}0027(u'')^2$, where $u = v + \frac{1}{2}$. The heat of dissociation for the upper state is calculated to be 6 510 cm^{-2}. The bands are due to transition from the ground $^1\Sigma_g^+$ state to an excited state which is probably $^1\Sigma_u^+$ in character. The dissociation products for the upper state are either $3\,^2S + 4\,^2P$ or $3\,^2S + 3\,^2D$ atoms of Na. A.

535.338.4 : 523.872

Molecular bands in spectra of early *R*-type stars. *See Abstr.* 1664

535.338.4 : 539.132

1814. An extension of the Swan system of the C_2 molecule. PHILLIPS, J. G. *Astrophys. J.*, **108**, 434–52 (*Nov.*, 1948).—The analysis of the Swan system ($A^3\Pi_g - X^3\Pi_u$) has been extended to higher vibrational levels through the study of the "tail" bands. Detailed analyses have been carried out on the bands at $\lambda\lambda$4770, 4395 and 4734, the last 2 being headless bands not previously mentioned in the literature. The (0, 2), (1, 3), (2, 4) and (3, 5) bands have also been analysed and the vibrational data for these and 6 "tail" bands are tabulated. All available rotational and vibrational data are then used to derive improved molecular constants for the 2 electronic states. A linear extrapolation of the vibrational quanta from the highest observed level at $v' = 10$ for the upper ($A^3\Pi_g$) state gives 5·30 as an upper limit for the dissociation energy of this state. Depending on whether it dissociates into ($^3P + {}^3P$) or ($^3P + {}^1D$) atoms, the upper limit to the heat of dissociation of C_2 is 5·30 or 4·04 eV. A. G. G.

535.338.4–15

1815. Infrared CN bands. HERZBERG, G. AND PHILLIPS, J. G. *Astrophys. J.*, **108**, 163–6 (*Sept.*, 1948).—A reinvestigation of the emission spectrum of CN from 7 000–15 000 Å shows the 0–0 band to be at 10 933 Å and other new bands are assigned. A revised Deslandres table and revised values of the molecular constants are given. D. H. W.

535.343–14 : 539.133 : 543.545

1816. Microwave spectroscopy. GORDY, W. *Rev. Mod. Phys.*, **20**, 668–717 (*Oct.*, 1948).—A comprehensive review of gas spectroscopy at wavelengths from 5 to 0·3 cm with sections on experimental methods; atomic, inversion, electronic and rotational spectra; line shapes; the Stark and Zeeman effects; and short sections on liquids, solids and analytical applications. The determination of moments of inertia, bond distances, vibrational frequencies, dipole moments, nuclear spins, quadrupole couplings, and other molecular quantities are described. There are full references and tables of line positions and derived quantities, including the following new molecular dimensions: C–N 1·157 Å in HCN; P–F 1·546 Å in PF_3; C–F 1·322 Å in CHF_3; C–F 1·384 Å, C–H 1·111 Å, ∠ HCH 110° 6′ in CH_3F; H_3C–N 1·426 Å, N–C 1·167 Å, ∠ CNC 180° in CH_3NC; B–C 1·540 Å, ∠ BCO 180° in BH_3CO, reasonable values being assumed for the remaining dimensions. A tentative value of 320 cm^{-1} is quoted for the barrier opposing internal rotation in CH_3OH. D. H. W.

535.343–15

1817. Infra-red spectrography with a lead sulphide cell. MATHIS, R. AND LARNAUDIE, M. *C.R. Acad. Sci., Paris*, **226**, 1714–16 (*May* 24, 1948) *In French.*—A PbS photocell with electronic amplifier and modulated light source has been used with a grating

spectrograph to resolve the 2·66 μ band of water vapour, 186 rotation lines being shown in a figure but not tabulated. The overall detector sensitivity is 2×10^{-8} lumens/mm of record. D. H. W.

535.343.3–15 : 535.61–15 : 541.57

1818. Infra-red spectra of compounds of high molecular weight. IV. Silicones and related compounds. RICHARDS, R. E. AND THOMPSON, H. W. *J. Chem. Soc.*, 124–32 (*Jan.*, 1949).—The vibrational spectra of some silicones and related substances have been measured between 2 and 20 μ. The compounds included a series of open-chain methylpolysiloxanes, the corresponding cyclic methylpolysiloxanes, some alkoxysilanes, some phenylsilanols and condensates, phenylsiloxanes, and chlorosilanes. The spectra have been correlated and several plausible vibrational assignments have been made. The results have also been discussed in terms of the nature and strength of the Si–O and Si–C bonds. A.

535.343.32–15

1819. Absorption spectra in the infra-red region. BERTI, L. *Nuovo Cim.*, **5**, 44–51 (*April*, 1948) *In Italian.*—Summarized account of the author's thesis. Some new intense, narrow absorption bands due to OH in ethyl alcohol and phenol, diluted in CCl_4, are described ($\sim$ 1–2 μ).

535.343.4 : 539.132 : 551.510.4

1820. Fine structure of the red system of atmospheric oxygen bands. BABCOCK, H. D. AND HERZBERG, L. *Astrophys. J.*, **108**, 167–90 (*Sept.*, 1948).—Improved high-dispersion spectrograms of the red bands of atmospheric O have been obtained, with air paths from 30 m to 100 km. For unblended lines of medium intensity the wavelengths have been determined with an accuracy of about one part in seven million, and as a result the molecular constants of O^{16}, $O^{16}O^{18}$ and $O^{16}O^{17}$ in the $^3\Sigma_g^-$ ground state and the $^1\Sigma_g^+$ excited state, have been evaluated much more precisely. Careful analysis shows a variation in the triplet splitting of the $^3\Sigma_g^-$ state which is dependent both on the vibrational quantum number and on the mass of the molecule, in addition to the variation due to the change of rotational energy. A.

535.343.4–14 : 539.133

1821. Microwave spectroscopy in the region of three to five millimeters. SMITH, A. G., GORDY, W., SIMMONS, J. W. AND SMITH, W. V. *Phys. Rev.*, **75**, 260–3 (*Jan.* 15, 1949).—Investigations in the electromagnetic spectrum between 3·3 and 5 mm wavelength have shown that useful work can be done here with available sources and detectors. Higher rotational transitions of BrCN and ICN have been observed with satisfactory signal-to-noise ratios at pressures low enough to resolve the nuclear quadrupole splittings. These measurements indicate that the minimum detectable absorption is 10^{-5} neper/cm with the present spectroscope. The B_0 value of CHN has been determined as 1·4789 cm^{-1}, in agreement with infrared results. The quadrupole coupling factor for the N nucleus in this molecule has been found to be 4·7 Mc/s. A.

535.343.4–14 : 539.133

1822. Rotational absorption spectrum of OCS. STRANDBERG, M. W. P., WENTINK, T., JR. AND KYHL, R. L. *Phys. Rev.*, **75**, 270–8 (*Jan.* 15, 1949).—Measurements in the microwave rotational spectrum of OCS are presented and correlated with the data obtained by other investigators. Precision measurements of rotational transitions for $J_1\rightarrow_2$, $J_2\rightarrow_3$, $J_3\rightarrow_4$, $J_4\rightarrow_5$ allow the evaluation of precise reciprocal moments of inertia in the ground vibrational state and the centrifugal distortion coefficient. From frequencies observed for $O^{16}C^{12}S^{32}$, $O^{16}C^{13}S^{32}$ and $O^{16}C^{12}S^{34}$, internuclear distances have been calculated. Equilibrium moments of inertia and internuclear distances cannot as yet be given, since thus far only one of the 3 vibrational-rotational interaction coefficients (α_2) has been reported. Theoretical considerations involving such equilibrium data are discussed. Data on *l*-doubling in $O^{16}C^{12}S^{32}$, $O^{16}C^{13}S^{32}$ and $O^{16}C^{14}S^{32}$ are presented. The Stark effect has been measured in $O^{16}C^{12}S^{32}$ and $O^{16}C^{13}S^{32}$. These measurements lead to the evaluation of the dipole moment and indicate the effect of isotopic changes on the dipole moment. A.

535.343.4–15

1823. Absorption spectra of methane in the near infrared. NELSON, R. C., PLYLER, E. K. AND BENEDICT, W. S. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 615–21 (*Dec.*, 1948).—A grating spectrometer with a PbS cell for detector has been used for the measurement of the infrared absorption bands of methane in the region of 1·66 μ. Many lines of the *P*, *Q* and *R* branches of the 1·66 μ band have been observed. These are well resolved and are of the correct structure and spacing for the F_2 component of $2\nu_3$. The lines for values of *J* up to 10 are sharp, showing no indication of splitting due to interaction with neighbouring states or to centrifugal distortion. The rotational constants obtained for this band are $B' = 5\cdot178$, $\zeta_3 = 0\cdot0346$. The latter value is lower than in the ν_3 fundamental. Other bands observed are more complex and irregular, presumably due to mutual interaction. A.

535.343.4–15 : 539.133

1824. Quadrupole rotation-vibration spectrum of the hydrogen molecule. HERZBERG, G. Letter in *Nature, Lond.*, **163**, 170 (*Jan.* 29, 1949).—Using a path of 22 m at 10 atm. of H_2 traversed 250 times, lines in the *S* and *Q* branches of the 2–0 ($\sim$ 8 000 cm^{-1}) and the 3–0 ($\sim$ 12 000 cm^{-1}) bands were found in absorption. These are permitted only as a result of the change of molecular quadrupole moment during vibration and their positions agree with the less accurate predictions. D. H. W.

535.343.4–31

1825. Absorption spectrum of 1,2,4-trichlorobenzene in the near ultraviolet. KOHN, H. AND SPONER, H. *J. Opt. Soc. Amer.*, **39**, 75–85 (*Jan.*, 1949).—The spectrum at 2 960–2 600 Å has been investigated using a medium Hilger quartz spectrograph. The band system corresponds to a transition $A' - A'$ (1,2,4-$C_6H_3Cl_3$ belongs to symmetry group C_s) with the transition moment lying in the molecular plane. The transition is allowed. In agreement with this assignment the 0–0 band appears strongly. Several progressions of symmetric vibrations and many combinations between them have been observed. A number of vibrational frequencies were identified with Raman frequencies. Characteristic of the spectrum is that

its bands are spaced very regularly, a difference of $\sim 30\ cm^{-1}$ being most prominent. These differences represent $v - v$ transitions of l.f. vibrations. A.

535.345–15 : 666

1826. Transmittance of near infrared energy by binary glasses. FLORENCE, J. M., GLAZE, F. W., HAHNER, C. H. AND STAIR, R. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 623–6 (*Dec.*, 1948).—A study has been made of the transmittance of near infrared energy by a number of binary glasses. Of the systems studied, the lithia-silica and lead oxide-silica were found to have the highest transmittance of energy in the range of wavelengths from 3·0 to 5·0 μ. The transmittance of lithia-silica is compared with that of the other alkali-silica glasses. Values of transmittance are given for lead silicate glasses of higher lead content than have been previously reported in the literature. A.

535.361.2

1827. Preparation and application of reproducible gloss standards. SMITH, D. AND MAHONEY, M. M. *J. Opt. Soc. Amer.*, **39**, 86–90 (*Jan.*, 1949).—A polystyrene replica technique, similar to that employed in electron microscopy, has been used to prepare extremely thin films of identical surface structure. These thin transparent films can be transferred to any desirable surface. Replicas made from gloss standards are shown to be reproducible in surface structure and spatial reflectance characteristics. A.

535.37

1828. Inertia effects in infra-red sensitive phosphors. SCOTT, F. R., THOMPSON, R. H. AND ELLICKSON, R. T. *J. Opt. Soc. Amer.*, **39**, 64–7 (*Jan.*, 1949).—Measurements are reported on the time required for an i.r. phosphor to acquire max. brightness when exposed to i.r. radiation. This time becomes smaller as the i.r. intensity is increased, but there seems to be no relationship between the 2 quantities. The data given are for phosphors composed of Sr sulphide or selenide activated with Eu and Sm. The brightness of Sr sulphide activated with Ce and Sm reaches its max. value in $< 10^{-4}$ sec, too short to be measured by the apparatus described. Results on some samples indicate the existence of two simultaneous processes. An appreciable fraction, $\simeq \frac{1}{2}$, of the final brightness is reached in $< 10^{-4}$ sec, while the ultimate value is approached more slowly. A.

535.37 : 535.34

1829. Temperature radiation of zinc oxide. KUDRYATSEVA, V. M. AND SINYAPKINA, G. I. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 8) 1411–14 (1948) *In Russian.*—There are still mistaken views about the so-called thermo-luminescence of some substances, including ZnO. The authors were able to show experimentally that the ZnO does not partake of a similar phenomenon and that all apparently thermal radiation processes of the substance are due to peculiarities of its absorption. The same holds for ZnS and TiO_2. It is well known that ZnO in the u.v. range behaves as a black body (up to 3 850 Å). At elevated temperatures, its absorption range shifts into the visible part of the spectrum. This behaviour was subjected to a detailed investigation and the constant character of the change in the absorption at the edge of the absorption band was found to extend from −180 to 950°c. In a comparatively narrow interval it falls from its constant high value to a very low one. New absorptivity and emissivity are related by Kirchhoff's formula, hence the parallelism between luminescence and absorption ranges—if any—can be checked. A strict parallelism of all experimental curves proves the narrow causal connection of the two phenomena. B. F. K.

535.37 : 537.226.2

1830. The optical and electrical properties of zinc silicate phosphors. NAGY, E. *J. Opt. Soc. Amer.*, **39**, 42–9 (*Jan.*, 1949).—The spectra of Zn silicates with varying concentrations of Mn were measured at several temperatures. These emission spectra could be separated into bands conforming to Gauss error curves and the location of these bands is almost unaffected by temperature and composition changes. The width of these bands increases linearly with temperature and the bands become wider as the activator concentration departs from the optimum. The dielectric losses of these phosphors were measured as a function of temperature and the very close connection between luminescence and dielectric losses first reported by Szigeti and Nagy for a Zn silicate sample was found valid for any Zn silicate. The electrical and luminescent constants all show maxima for the best fluorescing substances. These data make it doubtful that activation is confined to divalent Mn. Consequently, a close analogy between the emission spectra of these silicates and the absorption spectra of permanganate and manganate compounds is worth studying. A.

535.37 : 666.2 : 539.163

1831. Extinction of the luminescence of glasses and of uranyl salts. TOLSTOY, N. A. AND FEOFILOV, P. P. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 2) 235–8 (1948) *In Russian.*—Application of a new method for obtaining intensity curves on a C.R.O. The extinction curves of glasses containing Mn, Cu, U and Sm deviate from the form of an exponential curve (though sometimes not substantially), whereas the extinction of uranyl sulphate, uranyl potassium sulphate, and uranyl nitrate follows a strictly exponential law, which also applies to solutions of these salts. A dependence of the extinction time on specimen thickness was also established for the transparent effect, whereas the extinction time of the reflected luminescence remained constant. The curves are then discussed in more detail. B. F. K.

535.372

1832. Dependence of the relative quantic emission of the luminescence of ZnO on the exciting wavelength. VERGUNAS, F. I. AND GAVRILOV, F. F. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 7) 1273–5 (1948) *In Russian.*—The dependence of the spontaneous after-glow of ZnO on the exciting wavelength has never been reliably established owing to the difficulties in determining the absorption in powders (the most frequent state of crystallo-phosphors), and also to the long duration of the afterglow of such phosphors, a source of considerable errors in measuring the spontaneous emission. ZnO was selected for the investigation because it shows no phosphorescence and, on the

other hand, is available in thin transparent foils. Absorption, therefore, may be determined directly from the weakening of the transmitted light, thus avoiding the use of diffraction methods. Quantic emission is defined as (energy emission) × (quotient of the wavelengths of emitted and absorbed light) where energy emission is the ratio of radiated to absorbed energy. Thus the law of absorption and the spectral distribution of energy v. wavelength must be known. These were very carefully determined on pure ZnO for the spectral excitation domain of the Hg spectrum from 365 to 254 mμ. The luminescence of ZnO, according to the experimental results, seems to be caused by transitions of electrons from the localized levels of the free Zn atoms to the basic zone. This may be taken as agreeing with the experimental fact of the independence of the quantic emission on wavelength, as the probability of electron–hole recombination can hardly depend on the exciting wavelength. It was also shown that the quantic emission is independent of the exciting intensity, this fact again supporting the accepted mechanism of luminescence. The latter statement should be qualified as indicating the constancy of the luminescence at varying large excitations, more precisely over the whole range of the Hg spectrum (in which the intensity maximum at 365 mμ is 11× stronger than the min. at 330 mμ), whereas at very small excitations the luminescence effect was found to decrease proportionally to the exciting energy. B. F. K.

535.375.5 : 539.133 : 548.0

1833. Influence of temperature on the Raman spectra of crystals. III. Barytes. NARAYANASWAMY, P. K. *Proc. Indian Acad. Sci. A*, **28**, 40–6 (*Aug.*, 1948).—The Raman spectrum of barytes, excited by Hg 2 536 Å, was measured at 8 temperatures between 85 and 923°K. As temperature is raised, the frequency shift decreases and the internal frequencies of the SO_4'' ion coalesce from the completely split components exhibited at low temperature. Lattice oscillations are influenced more markedly than internal oscillations of the SO_4'' group. W. R. A.

535.375.5 : 548.0

1834. Circular polarization of Raman lines in crystals. COUTURE, L. AND MATHIEU, J.-P. *C.R. Acad. Sci., Paris*, **226**, 1596–7 (*May* 19, 1948) *In French.*—Values are given of the inversion coefficient (ratio of the intensity of the inverse vibration to that of the regular vibration) and of the intensity of the scattered light, for the different symmetry groups, the different types of fundamental vibrations, and the different cases arising experimentally. There are three cases (I, II and III) according as the axis OX, OY, or OZ of the polarizability ellipsoid of the crystal is directed along the axis OX of incident light and observation. In uniaxial crystals, I and II become the same, if OZ is taken as the principal axis. From the results tabulated, it is seen that in general, observation with circularly polarized light is not preferable to the ordinary method using plane polarized light, if the object is to assign types of vibration to the frequencies. However, for the total-symmetric vibrations of non-cubic crystals, a single observation settles the values of the diagonal coefficients of the tensor. A. C. M.

535.39 : 539.234

1835. Thin evaporated calcium fluoride films. BANNON, J. AND COOGAN, C. K. *Nature, Lond.*, **163**, 62–3 (*Jan.* 8, 1949).—The orientations of thin films of CaF_2 evaporated on polished glass surfaces at various temperatures are examined by X-ray and electron diffraction, the two sets of results being in agreement. At 25°C the (111) planes are parallel to the surface, but at 110°C and 310°C the (110) planes are parallel to the surface, within an angle ~ 15°. J. T.

535.39 : 539.234

1836. Techniques of evaporating multiple thin films. DUFOUR, C. *Le Vide*, **3**, 480–6 (*July–Sept.*, 1948) *In French.*—Deals with non-reflecting and semi-transparent films on glass. An apparatus adapted for the successive deposition of several different layers with means for continuous monitoring of the reflection is described in detail. A. H. W. B.

535.39 : 535.312/.313 : 539.234

1837. An investigation of the physical properties of thin films used in the reduction of surface reflection. DELL, H. A. *Proc. Phys. Soc., Lond. B*, **62**, 81–93 (*Feb.*, 1949).—A simple mathematical treatment of reflection from thin films. Reflection from multiple films of more than one substance is considered, as well as the reflection of polarized light from simple films. A photometer used for testing these results is described, and the different types of cryolite films found are enumerated. Evidence is given suggesting that polished or aged cryolite films behave as if they consisted of a lower stratum of cryolite surmounted by a secondary layer of higher refractive index. Some of the properties of this layer are described. A.

535.39 : 535.34 : 535.33 : 539.233

1838. Orientation of methylene blue molecules adsorbed on solids. ANDERSON, S. *J. Opt. Soc. Amer.*, **39**, 49–56 (*Jan.*, 1949).—The state of orientation of methylene blue molecules adsorbed on rubbed glasses has been investigated. Reflection spectra made with polarized visible radiation demonstrate conclusively that the long axis of the molecules is perp. to the direction in which the glass was originally rubbed. Absorption spectra with polarized i.r. radiation show, in addition, that the molecules are adsorbed on the glass with the plane of their benzene ring parallel to the glass. A.

535.41 : 535.543

1839. Haidinger fringes in a basal section of calcite. BILLINGS, B. H. *J. Opt. Soc. Amer.*, **39**, 39–41 (*Jan.*, 1949).—Haidinger fringes were obtained with a partly silvered basal section of calcite. Two sets of fringes were observed: one associated with the ordinary ray, and one with the extraordinary ray. With a linear polarizer the two series are separated on the pattern diameters parallel to the polarizer axes. The oppositely polarized fringes periodically coincide and give rise to beats or a moiré. An analysis is made to show that this coincidence occurs when the ratio of the fringe numbers of the coinciding fringes is the ratio of the squares of the two principal refractive indices. A.

535.417 : 535.33.072 : 535.61.08

1840. A new heterochromatic Fabry–Perot fringe system applicable to the interferometry of absorption spectra. TREANOR, P. J. Letter in *Nature, Lond.*, **162**,

885–6 (*Dec.* 4, 1948).—A description is given of a system, which, when used with a spectrograph of resolving power $\gtrsim 10^5$ at 5 890 Å, has a resolving power estimated at 4×10^5, with slit-width 0·2 mm. R. F. B.

535.42

1841. The generalised Malus–Dupin theorem and the inverse interference transformation. TORALDO DI FRANCIA, G. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2,** 787–90 (*June*, 1947) *In Italian.*—By applying the inverse interference transformation the Malus–Dupin theorem is formulated so as to apply to the case of a congruent beam incident upon a diffracting surface which imparts phase and amplitude variations to the wave-surface. H. H. HOP.

535.42

1842. On the theory of diffraction by an aperture in an infinite plane screen. I. LEVINE, H. AND SCHWINGER, J. *Phys. Rev.*, **74,** 958–74 (*Oct.* 15, 1948).—The wave function of a scalar plane wave at an arbitrary point in space is expressed in terms of its values in the aperture, and constructed so as to vanish on the screen, in accordance with the assumed boundary condition. An integral equation to determine the aperture field is obtained from the continuity requirement for the normal derivative of the wave function on traversing the plane of the aperture. Utilizing the integral equation (whose solution is generally unobtainable), the amplitude of the diffracted spherical wave at large distances from the aperture is exhibited in a form which is stationary with respect to small variations (relative to the correct values) of the aperture fields arising from a pair of incident waves. This expression is independent of the scale of the aperture fields. The transmission cross-section of the aperture for a plane wave is found to be simply related to the diffracted amplitude observed in the direction of incidence. The variational formulation is applied in detail for a wave incident normally on a circular aperture. By comparison with the exact results available for this problem, it appears that the use of suitable trial aperture fields in the variational formulation yields accurate expressions for the diffracted amplitude and transmission cross-section over a wide range of frequencies. A.

535.42 : 538.566 : 621.396.11

1843. Theory of the diffraction of electromagnetic waves by a perfectly conducting circular disc, and by a perfectly conducting plane screen with a circular aperture. MEIXNER, J. *Göttingen Nachr.* (*No.* 1) 74–5 (1946) *In German.*—An exact solution of the diffraction problem is possible for these two cases if the fields are expressed in terms of two radial vectors, allied to the Hertzian and Fitzgerald vectors. Both vectors obey the wave equation and the boundary conditions are simple. A. H. W. B.

535.421 : 535.33.072

1844. An extended theory of the reflection echelon grating. GRIFFIN, L. R. *Proc. Phys. Soc., Lond. B,* **62,** 93–100 (*Feb.*, 1949).—The single reflection echelon grating has the disadvantage that it is impossible to interpret the fringe pattern without further information about the correct order allocation. The present methods of obtaining this information are briefly reviewed; they are progressively less useful as λ decreases into the u.v. The properties of the grating are investigated theoretically when the light is incident at relatively large angles in two special cases, and the performance of the instrument in these positions compared with that of its normal use. It is shown that the required order allocation could be obtained using a single reflection echelon grating by measuring the fractional order separation with the grating in two positions. This would considerably increase the value of the instrument. A.

535.421 : 535.33.072

1845. Laminated gratings and their application to studies of the far infrared. MEVEL, J. *Rev. Opt.* (*Théor. Instrum.*) **27,** 661–77 (*Nov.*, 1948) *In French.*—A simple theoretical and practical treatment is given, based on Huygens' principle. The main principles of their production and the spectrometers using them are described. The laminar gratings are compared with other types used in far infra-red work. A.

535.43 : 522.24

1846. Diffusion produced by balsam in astronomical objectives used for special purposes. LYOT, B., FRANÇON, M. AND CAGNET, M. *Rev. Opt.* (*Théor. Instrum.*) **27,** 657–60 (1948) *In French.*—The extension of the spectral range of the coronagraph objective by using a two-glass corrected lens in place of a simple plano-convex lens is conditional on negligible diffusion of light by the layer of balsam. An investigation of this effect by photographic photometry has shown that no measurable influence would be caused by the balsam layer, so that the possibility of a corrected objective exists.

535.43 : 525.75 : 551.593

Spectral distribution of zenith-scattered radiation. *See Abstr.* 2251

535.43 : 551.521

Scattering of sunlight. *See Abstr.* 2252–3

535.51

1847. The geometry of extraordinary refraction. SETH, J. B. *Indian J. Phys.*, **22,** 379–90 (*Sept.*, 1948).—An expression has been deduced connecting the angle of refraction of the extraordinary ray (and of the extraordinary wave normal) in a uni-axial crystal with the angle of incidence and the inclination of the optic axis to the refracting surface. The usual special cases given in text books follow from the general expression. The peculiarities in the behaviour of the extraordinary ray at normal incidence but with different inclinations of the optic axis have been derived. A.

535.514.2 : 535.393

1848. Simultaneous measurement of the optical constants of metals over a wide wavelength range. BOR, J. AND CHAPMAN, B. G. *Nature, Lond.*, **163,** 183–4 (*Jan.* 29, 1949).—White light elliptically polarized by reflection at a metallic surface passes through two prisms of right- and left-handed quartz in optical contact, a Nicol suitably adjusted, a prism, two plano-cylindrical lenses arranged with their axes perpendicular, and falls on a photographic plate. A spectrum is obtained crossed by a system of dark and bright bands from which the orientation of the vibration ellipse and, by microphotometric comparison of the maxima and minima with a spectrum of graded intensity, the axial ratio are found. Experi-

ments with Au and Al over the wavelength 0·35–0·7 μ have been performed. [See Abstr. 4318, 4319 (1939)]. H. G. J.

535.55

1849. The optical equations of three-dimensional photoelasticity. MINDLIN, R. D. AND GOODMAN, L. E. *J. Appl. Phys.*, **20**, 89–95 (*Jan.*, 1949).—The fundamental optical problem encountered is that of the propagation of light in a heterogeneous, aeolotropic medium. Although there is an extensive literature on the homogeneous, aeolotropic medium and the heterogeneous, isotropic medium, only a few special cases of the combined problem have been studied from the point of view of Maxwell's electromagnetic equations. The most general approximate treatments is that of F. Neumann (1841), derived from purely kinematical considerations. In the present paper the passage from Maxwell's to Neumann's equations is executed and the nature and order of magnitude of the necessary approximations are disclosed. During the passage a pair of equations is discovered of relatively simple form, which opens the way to a variety of new solutions in closed form and reveals the essential parameter upon which the optical phenomena depend. A.

535.55 : 539.3

1850. A mathematical theory of photo-viscoelasticity. MINDLIN, R. D. *J. Appl. Phys.*, **20**, 204–16 (*Feb.*, 1949).—A phenomenological law of optical birefringence, induced by small strain in viscoelastic materials, is formulated and applied to an idealized medium. The resulting optical-stress-strain-time-temperature relations are used in finding conditions under which models made of viscoelastic materials may be employed in the photoelastic method of solving boundary-value problems in the linear theory of elasticity. A.

535.551 : 535.323 : 549.211

1851. The photoelastic properties of diamond. BURSTEIN, E. AND SMITH, P. L. Letter in *Phys. Rev.*, **74**, 1880–1 (*Dec.* 15, 1948).—Reference is made to an earlier work by Ramachandran giving values of the photoelastic constants of diamond, which later investigation has proved to be of the correct magnitude in units of cm^2/g^4 but of incorrect sign. The corrected photoelastic constants, atomic anisotropy constants and related quantities are given and their significance discussed. A necessary change and typographical errors in an earlier work by the same authors are mentioned. This leaves MgO as the only crystal known to have a negative dn/dp. [See Abstr. 3295 (1935), 2120 (1947), 3720 and 3721 (1948)]. H. G. J.

535.555

1852. Graphical calculation of polarization transformations. BOKSTEIN, M. F. *J. Tech. Phys., USSR*, **18** (*No.* 5) 673–8 (*May*, 1948) *In Russian.*—A graphical method is presented for calculating the transformations representing the polarized states of light, resulting from its passage through birefringent plates. The method is based on that of Poincaré and uses Wulf's net. The application of the method to obtaining circular polarization by combination of plates is considered as an example. B. F. K.

535.64/.65

1853. Colorimetric analysis of dye mixtures. MACADAM, D. L. *J. Opt. Soc. Amer.*, **39**, 22–30 (*Jan.*, 1949).—Distributions of chromaticities have been computed for 171 pairs of typical dyes, involving 5 yellows, 9 cyans, and 9 magentas. Beer's law was assumed, and the computations were performed on automatic, punched-card computing and tabulating machines. A selected ordinate method was used. The concentrations of the dyes in each mixture were considered to be varied systematically, so that 90 chromaticities were computed for each pair of dyes. Since each dye was used in combinations with each of as many as 18 other dyes, the results show the influence of various characteristics of spectrophotometric curves on chromaticity distribution, gamut, and luminous transmittance. Some computations were made to study the behaviours of neutral mixtures of triads of dyes when the concentrations of all components are changed by a common factor. A.

535.825 : 535.33.072–15

1854. Infra-red spectroscopy with the reflecting microscope in physics, chemistry, and biology. BARER, R., COLE, A. R. H. AND THOMPSON, H. W. *Nature, Lond.*, **163**, 198–201 (*Feb.* 5, 1949).—A Burch achromatic reflecting microscope was used in combination with a Perkin–Elmer infra-red spectrometer so that the spectra of particles 20 μ in diameter ($\sim 10^{-7}$ g) could be measured. Examples include compounds of biochemical interest, muscle, fibres, and also single crystals measured with polarized radiation. D. H. W.

535.87

1855. Sensitivity of a rapid test for high speed parabolic mirrors. RANK, D. H., YODER, P. AND VRABEL, J. *J. Opt. Soc. Amer.*, **39**, 36–8 (*Jan.*, 1949).—A rapid test developed for Schmidt cameras has been used in the testing of a large, high-speed parabola during figuring. Calculations are made which show quantitatively the state of perfection of figure obtainable by means of this test. Conditions are derived to show under what circumstances the test shows the maximum degree of correction. A.

535.87

1856. Aberrations in ellipsoidal mirrors used in infra-red spectrometers. NIELSEN, J. R. *J. Opt. Soc. Amer.*, **39**, 59–63 (*Jan.*, 1949).—Since long slits are used in i.r. spectrometers, the image of the exit slit formed by the ellipsoidal mirror will suffer aberrations which lower the sensitivity and tend to increase the time of response. General formulae are derived for these aberrations, and a typical aberration pattern is computed. It is shown how the formulae may be applied to choose the most favourable eccentricity of the ellipsoidal mirror. The relation between the general formulae and a formula given by Randall and Firestone is discussed. A.

535.89.08 : 621.327.312 : 778.55

1857. Intensity measurements on water-cooled high-pressure mercury lamps with additions of Cd and Zn. ELENBAAS, W. *Rev. Opt.* (*Théor. Instrum.*) **27**, 683–92 (*Nov.*, 1948) *In English.*—Curves of the visible part of the spectrum of water-cooled Hg-lamps with varying additions of Cd and Zn were taken. The

Clock and the Bouma methods of calculation were used for determining which of these discharge lamps comes closest to the high-intensity C-arc lamp as used for cinema projection. A.

HEAT 536

536.2 : 533.16 : 532.13

A theory of thermal conductance of liquids and highly compressed gases. *See Abstr.* 1733

536.2 : 534.11 : 517.946.9

Heat conduction boundary problems. *See Abstr.* 1630

536.2.08

1858. A new principle for the determination of thermal conductivity in small test bodies of homogeneous ceramic materials. STÅLHANE, B. *IVA, Stockholm*, **19** (*No.* 5) 199–200 (1948) *In English.*—The sample of almost hemispherical shape is soldered along its curved surface into a metal clamp, and the free side of the sample ground plane. A metal bead, renewed for every measurement, is pressed by a metal rod against the centre of the free side of the sample and makes good metallic contact over a circular area of exactly defined dimensions. The clamp and rod are maintained at fixed temperatures. The temperatures, t_1, t_2, t_3 respectively, of the clamp, contact and rod are measured by thermocouples. The specific thermal conductivity λ of the sample is given by $\lambda = \Lambda(t_3 - t_2)/4r_1(t_2 - t_1)$ where $1/\Lambda$ is the constant thermal resistance of the rod and r_1 is the radius of the contact area. From tests performed with silver beads it is claimed that the method can be used with precision and reproducibility on materials of $\lambda = 0{\cdot}002 - 0{\cdot}3$ cal. cm^{-1} $°C^{-1}$ $sec.^{-1}$. S. W.

536.2.08

1859. On a serious error detrimental to the determination of the fundamental time constant in certain thermokinetic problems. VERNOTTE, P. *C.R. Acad. Sci., Paris*, **227**, 1078–80 (*Nov.* 22, 1948) *In French.*—A rigorous treatment of the problem of thermal insulation [Abstr. 2472 (1933)] has shown that the fundamental time constant of the apparatus is long in spite of the inside insulation. The error in the previous discussion is attributed to the representation by an exponential function of short time constant of a curve of more complex structure. Two numerical examples are given. S. W.

536.21

1860. Non-stationary heat conduction in plates, cylinders and spheres. TRAUPEL, W. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 193–205 (*July*, 1948) *In German.*—The time-variation of the temperature field and the heat exchange between a plane plate, cylinder and sphere, and the surrounding heat-transferring medium, the temperature of which is a given function of time, t, are derived mathematically, assuming that the bodies are all at the same temperature at $t = 0$ and their surface conductances, densities and thermal conductivities are constant. The theory is extended to the general case of an arbitrary temperature distribution in the bodies at $t = 0$. As an example, the variation in temperature of a turbine rotor in a gaseous medium which is heated from 0 to 500°C at different rates, is calculated. The results are shown graphically. S. W.

536.21 : 531.44 : 621.316.3.066.6

1861. Calculation of the temperature development in a contact heated in the contact surface, and application to the problem of the temperature in a sliding contact. OOSTERKAMP, W. J. Letter in *J. Appl. Phys.*, **19**, 1180–1 (*Dec.*, 1948).—The similarity between the problem of heat dissipation treated by Holm [Abstr. 3295 (1948)] and that of the heat dissipation in an X-ray tube anode is pointed out. The anode focal spot corresponds to the contact area, a stationary anode to a stationary contact, and a rotating anode to a sliding contact. The formulae previously obtained [Oosterkamp, W. J., and Philips, L., *Philips Res. Rep.*, **3**, 49–59; 161–73; 303 (1948)] are applied to the contact problem and the results, shown graphically, are compared with Holm's. S. W.

536.23 : 531.788.7

1862. On the relation between the thermal conductivity of rarified gases and the sensitivity range of Pirani gauges. KERSTEN, J. A. H. Letter in *Physica, 's Grav.*, **14**, 567–8 (*Dec.*, 1948) *In English.*—The Pirani gauge fails when the mean free path λ is not $\ll$ certain distances within the system. This upper limit may be shifted to higher pressures, not by decreasing the wire-to-wall distance but by reducing the diameter, d, of the filament. This has been confirmed experimentally; with $d = 0{\cdot}0008$ cm the gauge operated at $0{\cdot}06$ mm ($\lambda = 0{\cdot}1$ cm) even though the diameter of the gauge tube was $2{\cdot}5$ cm, i.e. $\gg \lambda$. S. J. G.

536.24

1863. Heat transfer in sweat-cooled porous metal. WEINBAUM, S. AND WHEELER, H. L. *J. Appl. Phys.*, **20**, 113–22 (*Jan.*, 1949).—Formulae showing the temperature distributions along the length of a sweat-cooled bar and across a sweat-cooled hollow cylinder are derived.

536.24 : 536.7

1864. On the heat exchanges to a perfect gas. VILLEY, J. *C.R. Acad. Sci., Paris*, **226**, 1699–701 (*May* 24, 1948) *In French.*—It is required to find the heat received per unit mass of a fast flowing steady stream of a permanent gas which changes in temperature from T_1 to T_2. This is done for a perfect gas, by evaluating the specific heat C in the expression $Q = \int_{T_1}^{T_2} C dT$ using equations derived in previous papers on related topics. F. E. H.

536.24 : 541.183

1865. Numerical evaluation of equations describing transient heat and mass transfer in packed solids. KLINKENBERG, A. *Industr. Engng Chem.*, **40**, 1992–4 (*Oct.*, 1948).—The exact solutions can be approximated for all practical purposes by error functions. These may be read from a nomograph. A.

536.413.3 + 536.631

1866. On the thermal analysis and dilatometry of Cr_2O_3. JAFFRAY, J. AND VILOTEAU, J. *C.R. Acad.*

Sci., Paris, **226**, 1701–2 (*May* 24, 1948) *In French.*—The specific heats between −60 and 80°C of two amorphous and one crystalline specimen of Cr_2O_3 are stated to have been determined; no systematic differences were revealed, all three specimens having an anomalous rise in the specific heat with a maximum between 31·5 and 33·5°C. Using toluene, the thermal expansion of the three specimens was measured in the neighbourhood of 32°C, for both heating and cooling. There is no break in the specific-volume/temperature curve, but there is a sharp change in slope at 32·8 ± 0·1°C, the volume expansion coefficient rising to a maximum of 42 to 50×10^{-5} and then falling rapidly to $\simeq 12\times10^{-5}$ per deg. C. Marked hysteresis in the expansion was observed. The temperature, 32·8°C, corresponding to what appears to be a 2nd-order transition, differs considerably from the temperatures observed by others for maximum magnetic susceptibility. S. W.

536.42 : 537.221

Electrical effects at change of state of water. *See Abstr.* 1891

536.42 : 548.33 : 548.737

Thermal changes in beryllium oxyacetate. *See Abstr.* 2195

536.423.15

1867. Vapour pressures of inorganic substances. I. Beryllium. HOLDEN, R. B., SPEISER, R. AND JOHNSTON, H. L. *J. Amer. Chem. Soc.*, **70**, 3897–9 (*Nov.*, 1948).—The vapour pressure of solid Be has been measured from 1 171 to 1 552°K by the rate at which the metal surface evaporates into a vacuum, and also by the rate at which saturated metal vapour effuses through an orifice. The results are in good agreement. The condensation coefficient is 1. The mean value of ΔH_0° is 76 560 ± 370 g.cals. and ΔH_0° does not show any drift with temperature. The vapour pressure equation is $\log P(\text{atm.}) = 6\cdot186 + 1\cdot454\times10^{-4}\,T - (16\,734 \pm 80)/T$. W. R. A.

536.423.15 : 536.71

1868. Vapour pressure data for various substances (a graphical presentation). LAW, R. R. *Rev. Sci. Instrum.*, **19**, 920–2 (*Dec.*, 1948).—The curves of log p against log T and log t (p = vapour pressure in mm of Hg; T = deg. K and t = deg. C) are given for about 35 elements and for CO_2, SO_2, H_2O. They are based on the data critically selected by Ditchburn and Gilmour [Abstr. 1299 (1942)], with some extrapolation. S. J. G.

536.424 : 548.73 : 548.33

Modifications of manganese dioxide. *See Abstr.* 2194

536.46

1869. Theory of combustion velocity in combustible mixtures. BECHERT, K. *Z. Naturforsch*, **3a**, 584–90 (*Aug.–Nov.*, 1948) *In German.*—A condensed account of the first section of a full paper to be published later. It deals with stationary flames, in particular with reactions between molecules of one kind. An example is ozone combustion. A differential equation for the fuel particle number as a function of temperature, with flame velocity as a parameter, is solved (neglecting diffusion) by an approximation method. The agreement with data for ozone is said to be satisfactory. H. MO.

536.46 : 541.126

1870. The influence of diffusion on flame propagation. GAYDON, A. G. AND WOLFHARD, H. G. *Proc. Roy. Soc. A*, **196** (*No.* 1044) 105–13 (1949).—Observations on the thickness of the luminous reaction zone and flame velocity in low-pressure flames of premixed gases are compared with deductions assuming that the flame is propagated by diffusion of free atoms or radicals; satisfactory agreement is obtained. A purely thermal mechanism of flame propagation is inadequate. A. G. G.

536.461

1871. Theories and phenomena of flame propagation. BROEZE, J. J. *Ingenieur*, **61**, O.1–9 (*Jan.* 7, 1949) *In English.*—The Gouy, or Bunsen-burner, method of measuring combustion velocities is critically examined. It is shown that the reaction zone is not the visible cone, but a similarly shaped surface lying within the visible cone and separated from it by about 1 mm. The reaction zone may be made visible by the Schlieren technique or by injecting fine smoke particles into the gas mixture. The Schlieren reaction zone should not be used in measurements of the combustion velocity of rich mixtures; errors arise under these conditions, which are characterized by non-parallelism of the Schlieren zone and the visible cone. Combustion velocities of propane- and butane-air mixtures were measured. The mixture strengths ranged from 10 to 20% weaker than stoichiometric to 60% richer, and the gas temperature before combustion was between 20°C and 200°C. It was found that the combustion velocity increases linearly with temperature. A hydrodynamic theory of flame stability is presented. It is assumed that for some distance from the burner mouth the transverse variation of mixture strength and gas velocity in the mixing layer is linear. For low main-stream gas velocities there is a point in the mixing layer at which the gas velocity is equal to the flame velocity corresponding to the local mixture strength. A stable flame establishes itself at this point. For velocities greater than a certain critical value (the "blow-off" point) no such stable condition is possible. Calculation of the variation of blow-off velocity with composition of the main gas stream gives results in good agreement with experiment. A. SCH.

536.48

1872. Irreversible processes in liquid helium II. GORTER, C. J. Letter in *Phys. Rev.*, **74**, 1544–5 (*Nov.* 15, 1948).—A discussion of the heat flow at zero mass transport on the basis of the 2-phase model according to which the heat transport is due to opposite movements of the two phases under the influence of the thermomechanical effect. In 5–15 μ slits the flow resistance is mainly due to the Poiseuille flow of the normal phase. In narrower slits the heat flow is higher. This is tentatively ascribed to a mean-free-path effect of the normal phase. In wide slits the mutual interaction between the two phases becomes important. Assuming a force of mutual friction per unit volume $M = A\rho_s\rho_n(v_s - v_n)^3$, with $A \simeq$ 50 cm sec/gram the observed heat flow, which is $\propto$ (grad T)$^{\frac{1}{3}}$ can be explained (ρ_s, ρ_n are the densities and v_s, v_n the velocities of the superfluid and normal phases). H. L.

536.48

1873. Green's theory of liquid He. TISZA, L.; GREEN, H. S. Letter in *Nature, Lond.*, **163**, 102–3 (*Jan.* 15, 1949).—Green's theory [Abstr. 2112 (1948)] is criticized as not yet being in a form that leads to Tisza's thermo-hydrodynamics which gives a correct phenomenological description of the properties of He II. The viscosity changes at the λ-point and the relevance of Bose–Einstein condensation are discussed. In his reply Green agrees that there is a necessity for the modification of the classical formulation of the laws of hydrodynamics and thermodynamics, and thinks the main criticism is founded on a mistaken identification of Born and Green's "potential viscosity" with Tisza's "dynamic viscosity." Reference is made to a new paper by Green [Abstr. 2375 (1948)] which the author believes to be in agreement with all experimental evidence. H. L.

536.48 : 532.7

1874. A contribution to the theory of liquid helium II. MOTT, N. F. *Phil. Mag.*, **40**, 61–71 (*Jan.*, 1949).—A theory is given of (1) liquid helium's behaviour as a mixture of a superfluid and a normal fluid, (2) the behaviour of the Rollin film, (3) the existence of a critical velocity in flow through capillaries above which viscosity appears. The theory is based on London's concept of a condensed Einstein–Bose gas and Bijl, de Boer and Michels' explanation of the energy gap between the lowest state and the excited states. To the approx. to which interaction between pairs of atoms alone is considered, the theory accounts well for the phenomena that depend on the "two-fluid" model of Landau and Tisza [Abstr. 252 (1948)]. A.

536.48 : 534.22

1875. Second sound and the behaviour of helium II. DINGLE, R. B. *Proc. Phys. Soc., Lond. A*, **62**, 154–66 (*March* 1, 1949).—Some theoretical consequences of the existence of second sound in He II are discussed. A method is suggested for setting up a quantitative phenomenological description of the thermodynamical behaviour of He II. It is known that expressions for the velocities of first and second sound may be obtained by using quite general models. The thermodynamical behaviour may be described in terms of the velocities of these 2 types of sound, so that it becomes possible, in principle, to obtain explicit values of the unknowns by combining the 2 sets of equations. On the basis of these ideas a discussion is given of the coeff. of thermal expansion of He, the ordinary thermal conductivity, and the attenuation of second sound. The paper contains a discussion of the modifications necessary to the Debye theory of specific heats when the sound velocities are temperature-dependent. A.

536.48 : 536.71

1876. The melting pressure of helium II. HAGGENMACHER, J. E. Letter in *Phys. Rev.*, **74**, 1539 (*Nov.* 15, 1948).—An empirical formula containing 4 constants which reproduces the experiments by Keesom and Keesom between 1·15 and 1·78°K with a maximum deviation of 0·3%. The formula does not give $\lim_{T\to 0} dp/dT = 0$. H. L.

536.48 : 537.312.62

A model of the superconductor. *See Abstr.* 1915

536.48 : 537.312.62 : 621.317.39 : 531.7

Liquid helium depth gauge. *See Abstr.* 1708

536.48 : 538.224

Magnetic behaviour of Zn and Cd at low temperatures. *See Abstr.* 2012

536.48 : 539.152.1

Nuclear polarization at low temperatures. *See Abstr.* 2047

536.48 : 539.155.2 : 536.71

1877. The properties of the condenser phase of the light helium isotope. DE BOER, J. AND LUNBECK, R. J. *Physica, 's Grav.*, **14**, 510–19 (*Dec.*, 1948) *In English.*—Using the principles of the law of corresponding states, adapted to the quantum theory as in previous papers [Abstr. 2460 (1948)], a number of properties of He^3 can be predicted as to their order of magnitude. The critical temperature and pressure $\simeq 3\cdot2$–$3\cdot5$°K and $0\cdot9$–$1\cdot2$ atm, respectively. The density at 0°K $\simeq 65\%$ of the internal energy $\simeq 35\%$ of the value of He^4. The vapour-pressure formula should be $\log_{10} P\,\mathrm{cm} = -1\cdot12/T + \frac{5}{2}\log T + 1\cdot01$ giving at 0·3°K a vapour pressure of 10^{-3} mm Hg. Finally the concentration ratios in vapour and liquid of a dilute mixture of He^3 in He^4 have been calculated and are compared with experiments [Abstr. 2535 (1948)]. A.

536.5.081

1878. Proposals for an international temperature scale. BOZZA, G. *Nuovo Cim.*, **5**, 107–10 (*April*, 1948) *In Italian.*—The scale proposed by the U.S. National Bureau of Standards is given in detail. The main changes are: the Ag-point from 960·5 to 960·8°C; the substitution of the triple point of water for the ice-point; the termination of the scale at the oxygen-point instead of −190°C; and the division of the scale at the antimony-point ($\simeq$ 630°C) instead of 660°C. S. W.

536.51 : 621.317.39 : 621.317.733

1879. An apparatus for measuring small temperature changes in liquids. GREENHILL, E. B. AND WHITEHEAD, J. R. *J. Sci. Instrum. Phys. Ind.*, **26**, 92–5 (*March*, 1949).—An apparatus is described for recording temperature changes of $\sim 0\cdot01$°C to an accuracy of 0·0002°C. The thermosensitive element used is a thermistor which forms part of a d.c. Wheatstone bridge. The bridge is automatically balanced by feeding back an a.c., $\propto$ the off-balance current, to heat a second thermistor in the opposite arm to the first. The magnitude of the a.c. is a measure of the temperature of the first thermistor, inside the calorimeter, and is recorded on a suitable instrument. The apparatus is calibrated by feeding into the calorimeter known amounts of electrical energy from a small heating coil. The apparatus has been used for the determination of heats of wetting and of adsorption when fine-grained powders are immersed in various liquids and solutions. A.

536.52 : 535.233.5

The determination of the true temperature of incandescent tungsten. *See Abstr.* 1784

536.53

1880. Response characteristics of thermometer elements. HORNFECK, A. J. *Trans. Amer. Soc. Mech. Engrs*, **71**, 121–33 (*Feb.*, 1949).—The paper discusses the significance of the time constant as a basis of comparison of elements and shows quantitatively the effects of varying socket size, materials, and internal element structure. The relation between the heat-transfer rate from the surrounding medium to the socket wall and the element response is shown by response data for a number of designs tested in air and water. Methods are given for determining the temp./time response curves of elements in a medium whose temperature is changing suddenly, uniformly, and sinusoidally as a function of time. A.

536.532

1881. Temperature measurements on liquid steel. FORNANDER, S. *Trans. Instrum. Meas. Conf. Stockholm* (1947) (*Norrköpings Tidningars Aktiebolag*) 223–7. *In English.*—Early techniques in thermoelectric temperature measurement of liquid steel used lagged couples to reduce thermal shock on immersion, with consequent slow response. A Pt/Pt–Rh couple in a vitreous silica sheath may be used unlagged and gives quick readings so that the head need only be immersed for about 15 sec, short enough to prevent corrosion. Tests show that the accuracy and reproducibility of the results are sufficient, between 50 and 80 determinations being possible before changing the hot junction, according to the type of furnace in use. E. D. H.

536.581

1882. A method of controlling rate of change of temperature. BIGG, P. H. AND JONES, F. D. *J. Sci. Instrum. Phys. Ind.*, **26**, 109–11 (*March*, 1949).—Rate of change of temperature may be controlled automatically by transforming it into a temperature difference, through the agency of differing thermal time constants, and using this temperature difference to control the heat input or extraction. A general description of a particular application is given. It is suggested that the principle could be adapted to precise control of rate of change of temperature under a variety of circumstances from a small water bath in the laboratory to an annealing oven in industry. A.

536.62

1883. A new differential and compensated microcalorimeter. CALVET, E. *C.R. Acad. Sci., Paris*, **226**, 1702–4 (*May* 24, 1948) *In French.*—A twin differential compensated microcalorimeter for thermal processes of long duration, which functions at all temperatures and does not require a constant-temperature room, is described. The calorimeters, together with Zernicke galvanometer (1 mm deflection corresponds to 10^{-3} cal/hr) and switch, are inside a large Cu block. The thermostat, in which the block is situated, serves merely to fix the temperature of the experiment. Compensation is made by the Peltier effect. S. W.

536.62 : 536.66 : 541.57

1884. The bond dissociation energies of Cd–Ch_3 in $Cd(CH_3)_2$, and of CH_3–I in CH_3I. CARSON, A. S., HARTLEY, K. AND SKINNER, H. A. *Proc. Roy. Soc. A*, **195** (*No.* 1043) 500–12 (1948).—An adiabatic calorimetric system suitable for the study of reactions *in vacuo* and of reactions generating gaseous products is described. The system has been used to measure the heat of hydrolysis of Cd dimethyl by water and dilute H_2SO_4, and to measure its heat of reaction with I_2 in ethereal solution. A.

536.63

1885. Empirical heat capacity equations of gases and graphite. SPENCER, H. M. *Industr. Engng Chem.*, **40**, 2152–63 (*Nov.*, 1948).—The equations have been obtained for solid graphite and 117 gases in the hypothetical ideal state at 1 atm., mostly for the range between 298·16° and 1 500°K. They include 17 paraffins, 39 mono-olefins, 12 acetylenes, 20 alkylbenzenes, 10 cyclopentanes, and 17 cyclohexanes. The other gases are acetaldehyde, boron tribromide, boron trichloride, boron trifluoride, ethanol, nitric oxide, styrene, and several methyl styrenes. General equations representing the heat capacities of paraffins, mono-olefins, acetylenes, alkyl benzenes, alkyl cyclopentanes, and alkyl cyclohexanes in the gaseous state are presented. A.

536.63 : 536.7

1886. Composition, energy content and specific heat of air at high temperatures. BURKHARDT, G. *Z. Naturforsch.*, **3a**, 603–7 (*Aug.–Nov.*, 1948) *In German.*—The composition of air (ions, electrons, atoms, molecules) is calculated for temperatures up to 30 000°, and the energy content and specific heat are also determined. The data were computed for the purpose of research on high pressure waves and may also be valuable for work on gas discharges. H. MO.

536.631 : 537.311 : 621.3.011.2 : 669.12

1887. The specific heat and resistivity of high-purity iron up to 1 250°C. PALLISTER, P. R. *J. Iron Steel Inst.*, **161**, 87–90 (*Feb.*, 1949).—To obtain the true sp. ht. of high-purity Fe in a state of thermal equilibrium, a method is adopted in which the observed temp. increments are small, and the intervals between observations are occupied by slow heating or cooling of the annealed specimen. The sample rod is mounted in an evacuated electric furnace and maintained at any desired temperature up to 1 250°C. Then a momentary electric current is passed, heating the rod through 1 or 2°C. Radiation losses to the furnace tube are substantially reduced by the employment of a suitable concentric shield, electrically in series with the rod, so that the passage of the current heats them both coincidentally in magnitude and time. Electrical resistivity measurements, which are required for the evaluation of the energy delivered to the rod, are interspersed among the observations over the whole range of temperature. At 0°C the sp. ht and resistivity are respectively 0·104, 8·86 $\mu\Omega$/cm; at 1 250°C, 0·16 and 123·1 $\mu\Omega$/cm. A.

THERMODYNAMICS 536.7/.8

536.71

1888. The second virial coefficients of organic vapours. LAMBERT, J. D., ROBERTS, G. A. H., ROWLINSON, J. S. AND WILKINSON, V. J. *Proc. Roy. Soc. A*, **196** (*No.* 1044) 113–25 (1949).—The compressibilities of a number of organic vapours have

been measured at pressures up to 1 atm. and temps. from 40 to 130°C. The observed second virial coeffs. are compared with values calculated from the critical data by the Berthelot equation. The results show two distinct classes of behaviour. Class I is shown by ethane, ethylene, *n*-hexane, cyclohexane, benzene, diethyl ether, ethyl chloride, chloroform and carbon tetrachloride, where the measured second virial coeffs. are in agreement with the calculated values. Class II by acetaldehyde, acetone, acetonitrile, methyl alcohol, where the measured second virial coeffs. are consistently $\geqslant$ the calculated values. It is concluded that the vapours of polar substances for which the energy of attraction between molecules, due to dipole interaction or to hydrogen bonding, is larger than kT undergo dimerization. This view is supported by thermal conductivity data. The range of validity of the Berthelot equation for both non-polar and polar vapours is examined. A.

536.71 : 532.7

A general kinetic theory of liquids. The equation of state. *See Abstr.* 1728

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.122

1889. On the theory of the "luminous" electron. IVANENKO, D. AND SOKOLOV, A. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 9) 1551–4 (1948) *In Russian.*—A full theory of the e.m. radiation from electrons accelerated to $\sim 10^8$ eV in betatrons is given. As the intensities of higher multipoles of the order n are obtained by multiplying the dipole intensity by n, consideration of non-relativistic velocities may simply be based on dipole radiation. The ultra-relativistic case, however, requires a separate investigation of the dependence of the distribution of radiation on n. Integration of the vector potential by aid of Poynting's vector (giving the energy distribution of the n-th harmonic) and summation yields the distribution of the radiation in space which is practically concentrated in a plane. Integration of the energy formula gives the spectral distribution in ordinals of the harmonics. The latter formula is inconvenient as the harmonic ordinal numbers appear as argument and as ordinals of Bessel functions as well. The methods of approximation of Brillouin, Wentzel and Kramers applied to a second order diff. equation yield a good approximation for large values of the argument. A method given previously by one of the authors enables the approximation to be extended over the whole range of values of the argument, i.e. to exclude discontinuities. Two extreme cases are then discussed and an expression for the rate of energy decrease at extremely high frequencies is derived. B. F. K.

537.122 : 530.145

Magnetic moment of the electron. *See Abstr.* 1694

537.122 : 539.11 : 536.63

1890. Electronic specific heat of Al. MATYÁŠ, Z. *Čas. Pěst. Mat. Fis.*, **73** (*No.* 2) 79–87 (1948) *In English.*—Calculation of electronic specific heat from the distribution of electrons in the zone picture of Al previously derived by the author [Abstr. 2462 (1948)]. Good agreement with experiments by Kok and Keesom. H. L.

537.13 : 539.185 : 530.145

The magnetic moment of the proton. *See Abstr.* 1701

ELECTROSTATICS . DIELECTRICS 537.2

537.221 : 536.42

1891. Electrical effects associated with change of state of water. DINGER, J. E. AND GUNN, R. *Terr. Magn. Atmos. Elect.*, **51**, 477–94 (*Dec.*, 1946).—A method of measuring the contact potential accompanying the freezing or melting of H_2O is described. A change of approx. 10 V. occurs rapidly at the time of freezing of the surface of the H_2O; after freezing the contact potential decreases at a rate depending on the temp. of the ice until the potential is approx. that which existed before freezing. The melting of the ice produces no appreciable change in the contact potential. The charge acquired by air in passing over a given vol. of freezing or melting H_2O, and that acquired by the H_2O on melting have been determined. H_2O on melting acquires a positive charge of about 125 e.s.u./cm^3 of melted H_2O, the surrounding air acquiring a similar negative charge. The presence of impurities reduces and may neutralize this charging effect, but the presence of dissolved gases is essential for the occurrence of the effect. This indicates that the phenomenon is related to the cataphoresis of gas bubbles. A. J. M.

537.221 : 551.594

1892. Contact potential difference between water and ice. ARABADZHI, V. I. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 5) 811–12 (1948) *In Russian.*—There are no reliable data available on the p.d. of the water-ice contact which is important in meteorology. (According to the author, the collision between water droplets and ice crystals in thunder clouds is the cause of atmospheric electricity. Simpson's observation that the boundary between +ve and −ve electricity in clouds on an isothermal of ~ -15°C approximately coincides with the boundary between the water and ice phase may be taken to confirm this, all the more as the maximum field gradient in clouds also follows this isothermal). The method of the measurements was given by Frumkin [*Nature*, Aug. 2 (1924)] and the set-up included a RaTh collector and Wulf electrometer with a sensitivity of 30 sc.div./V, the collector being screened against outer influences. The contact p.d. was found to be $0{\cdot}17 \pm 0{\cdot}025$ V.

B. F. K.

537.226 : 538.12

Minimum integrals in field theory. *See Abstr.* 1996

537.226 : 621.3.011.5 : 621.315.612

1893. Structure and dielectric properties of barium titanate and similar compounds. DEVONSHIRE, A. F. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T*185) 15 *pp.* (1948).—The theory of the dielectric properties and crystal structure of barium titanate is discussed. It is suggested that at low temperatures the polarizability of the substance just exceeds the critical value required for self-polarization, so that it becomes permanently polarized in domains. It is shown that if the anharmonic terms in the vibrations of the ions are taken into account, the polarizability will decrease with increasing temperatures. The transition to a normal state above a certain temperature is thus explained. The theory also accounts satisfactorily for the very large permittivities above the transition temperature and for the magnitude of the permanent polarization in the region below the transition temperature. A.

537.226 : 621.315.61.011.5

1894. Polarization of dielectrics by slow particles. FRÖHLICH, H. AND PELZER, H. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T*184) 8 *pp.* (1948).—A knowledge of the motion of slow, charged particles through dielectrics is required for the theory of electric breakdown. As a first step, a point charge moving with constant velocity through dielectrics such as ionic crystals possessing proper frequencies of oscillation, is considered, and the energy transferred to the dielectric is calculated. The results are also of interest in connection with electronic conductivity in strong fields and the gradual slowing down of heavy particles and mesons, and may have possible applications in the discussion of nuclear forces. E. R.

537.226.08 : 621.317.37

1895. The lamina method of determining dielectric permittivity and loss angle tangent. ELTSIN, I. A. *J. Tech. Phys., USSR,* **18** (*No.* 5) 657–64 (1948) *In Russian.*—The strict theory is given of the method using a thin lamina placed in a tuned Lecher circuit. The formulae obtained are applied at $\lambda = 336$ cm for various solid dielectrics. B. F. K.

537.226.2

1896. Anomalous dielectric properties of polycrystalline titanates of the perovskite type. PARTINGTON, J. R., PLANER, G. V. AND BOSWELL, I. I. *Phil. Mag.*, **40,** 157–75 (*Feb.*, 1949).—A study of dielectric residual effects in $BaTiO_3$ and similar compounds possessing structures of the perovskite type was made. Permittivity/temperature curves were determined for various compositions. Variations in permittivity during and after the application of strong electric fields were studied at temperatures below and above the Curie points. New effects were revealed by the permittivity/time curves so obtained. A temporary increase in permittivity resulted after the application of the field at temperatures below the Curie point, while above the latter a temporary decrease took place. During the application of a superimposed field below the Curie point, the permittivity at first increased and then fell gradually to a value below its initial magnitude. Above the Curie point it decreased immediately, again approaching a reduced value. A mechanism is proposed for the effects observed. A.

537.226.2 : 535.37

Electrical properties of Zn silicate phosphors. *See Abstr.* 1830

537.226.2 : 537.221

1897. On the carnauba wax electret. GROSS, B. *An. Acad. Brasil. Ciênc.*, **20,** 247–53 (*Sept.*, 1948) *In English.*—A systematic study of the permanent surface charges which lead to the formation of the electret is reported. The current in the external circuit and the charge on one of the electrodes of the capacitor containing the sample are measured during the application of the polarizing field and after withdrawal of the field and short circuiting. This enables the current across the interface to be split into its 2 components, viz., exchange of charge carriers (conduction current) and internal rearrangement of charge and dipole rotation (absorption current). An improved dissectible capacitor is used. The results are shown graphically and demonstrate the coexistence of the 2 types of charges. These may have opposite polarities and serve to explain the phenomena observed. With a sufficiently high applied voltage surface breakdown occurs which causes the transfer of an ionic charge to the surface of the dielectric; with constant voltage the induced charge is seen to undergo discontinuous variations. Calculation shows that the highest field which can be achieved under the experimental conditions is ~ 70 kV/cm. A. M. T.

537.226.2 : 537.52

Dielectric properties of a gas discharge. *See Abstr.* 1920

537.228.1 : 621.396.611.21 : 621.3.012.8

1898. The equivalent circuit of the Curie double strip. POST, E. J. *Appl. Sci. Res.*, **B 1,** 168–80 (1948) *In English.*—A dynamical theory is given of the piezoelectric vibrating Curie strip. It is shown that the equivalent constants for the bending mode are closely related to those of the corresponding longitudinal lengthwise vibration. The numerical theoretical conclusions are compared with the data of experiments carried out on some double strips and with experimental data given by C. E. Lane, [Abstr. 1656 B (1946)]. A.

537.228.4 : 621.383 : 621.396.615.17

1899. An electronically operated Kerr cell shutter. FROOME, K. D. *J. Sci. Instrum. Phys. Ind.*, **25,** 371–3 (*Nov.*, 1948).—A circuit is described for producing a sequence of 10–12 kV square wave pulses suitable for operating a small Kerr cell shutter. The width of the pulses (i.e. the shutter exposure) and the interval between them can be varied independently from each other. The number of exposures can likewise be altered, and provision is also made for single exposures. A.

ELECTRIC CONDUCTION . CURRENTS . 537.3

537.311

1900. Space charge effects in bombardment conductivity through diamond. NEWTON, R. R. *Phys. Rev.*, **75,** 233–46 (*Jan.* 15, 1949).—Electrons excited to the conduction band of an insulator under electron

bombardment are, in general, not able to leave the insulator, but become trapped at imperfections in the crystal lattice. The trapped electrons give rise to a space charge which modifies the motion of electrons excited to the conduction band subsequent to the trapping. The current through the crystal thus becomes a function of time. A tentative theory of such space charge effects is presented and compared with experiment. Agreement with the data which exist at present is reasonably good. Some predictions and suggestions for future experiments are made. A.

537.311 : 621.3.011.2 : 669.12 : 536.631

Resistivity of high-purity Fe up to 1 250°C. *See Abstr.* 1887

537.311.31

1901. The size-variation of resistivity for mercury and tin. ANDREW, E. R. *Proc. Phys. Soc., Lond. A*, **62**, 77–87 (*Feb.* 1, 1949).—Measurements have been made of the low temp. resistivity of Hg wires down to 6 μ diameter and of rolled Sn foils down to 3 μ thickness. A continuous increase of resistivity with decrease of diameter and thickness was found, and it is concluded that this was due to a shortening of the mean free path of the conduction electrons by inelastic collision with the boundary surfaces of the metal. The theory of this effect for a wire is examined; a rigorous theory for a foil already exists [Abstr. 1276 (1938)]. By comparing the experimental results with the theory, values of the product $l\rho$ are found for both metals; (l is the mean free path and ρ the resistivity for the metal in bulk). These values of $l\rho$ are in satisfactory agreement with those obtained from Pippard's measurements on the anomalous skin effect for the two metals. A.

537.311.33

1902. The electrical conductivity of chromium sesquioxide at moderately high temperatures. JAFFRAY, J. AND BEAUFORT, M.-F. *C.R. Acad. Sci., Paris*, **227**, 1345–7 (*Dec.* 20, 1948) *In French.*—The conductivity σ of amorphous and crystalline specimens is measured between 0° and 100°C. On application of a voltage E the initial current I_0 is large but falls rapidly to a limiting value I_∞. The ratio E/I_∞ is constant. The initially large current is believed due to absorbed water. Values of σ_∞ at room temperature are 10^{-8} to 10^{-9} ohm^{-1}cm^{-1}. The usual log σ_∞, $1/T$, variation for semi-conductors is found with a low temp. activation energy of 0·5 eV, and $\frac{1}{2}$ this at higher temps., as for Cu_2O and SnS. An anomaly at 33°C was not confirmed. C. A. H.

537.311.33 : 537.312.6

1903. Electroconductivity of the system zinc-antimony. MOCHAN, I. V. *J. Tech. Phys., USSR*, **18**, 1485–93 (*Dec.*, 1948) *In Russian.*—The electrical conductivity σ and temp. coefficient of σ for the system Sb–Zn are measured in the neighbourhood of the stoichiometric point SbZn. The method of Vekshinsky was employed for preparation of the various alloys. This consisted in simultaneously evaporating the two metals, independently, in the form of spheres, in a vacuum on to glass targets cooled with liquid air. By measuring the weights of the metals before and after evaporation, and their distances from the target which was shielded with a screen to give layers of the alloys in the form of strips on the target, the relative amounts of the metals in the strips can be calculated, each strip having a different composition according to its position. The strips were removed and σ measured (*a*) immediately after removal, (*b*) 5 days after, (*c*) 15 days after removal, (*d*) after heating to 300°C in the course of 3 hours, and (*e*) after heating to 100°C in the course of 4 hours. It was found that σ in the neighbourhood of SbZn is of the order 10^{-3} ohm^{-1}cm^{-1}. σ for compounds of Sb and Zn is 10^6 times $< \sigma$ for parts of target where metal is approximately 100%. The temp. variation of σ showed that for part of the target where there is excess of one component there is a slight decrease in σ with temp. and the temp. coefficient of σ is of the same order as for the metal. Near point SbZn, σ increases exponentially with temp. In the system of energy levels of SbZn the width of the forbidden zone is 0·6 eV. SbZn is a semi-conductor and the character of the intermetallic bonds is non-metallic. W. H.

537.311.33 : 537.312.6 : 538.632 : 541.57

1904. Physical properties of intermetallic compounds of constant composition. (On the mechanism of conductivity of Mg_3Sb_2.) BOLTAKS, B. I. AND ZHUZE, V. P. *J. Tech. Phys., USSR*, **18**, 1459–77 (*Dec.*, 1948) *In Russian.*—A general survey is given of present-day knowledge of the nature of bonds in intermetallic compounds. Electrical conductivity σ and variation of σ with temperature, Hall effect, thermoelectric force, and thermal conductivity are experimentally determined for the system Mg–Sb in the neighbourhood of the stoichiometric point Mg_3Sb_2. σ has minimum values between 10^{-4} and 10^{-5} ohm^{-1} cm^{-1} at the point Mg_3Sb_2, the thermal conductivity also having a min. value of 0·0023 cal/cm/sec at this point. It was found that the width of the forbidden zone in the system of energy levels of Mg_3Sb_2 is 0·6–0·8 eV. The low concentration of free charge carriers as determined by measurements of the Hall effect showed them to be insufficient for the formation of metallic bonds. Bond strengths in Mg_3Sb_2 have their origin in valency bonds of ionic crystals, as was confirmed by the structure of the compound, which is characterized by a small co-ordination number, high melting point and large heat of formation (13·7 cal/g/mol). It is concluded that Mg_3Sb_2 is a typical representative of a phase of constant composition and according to its electrical properties appears to be an alloyed semi-conductor. W. H.

537.311.4 : 532.696.1 : 621.3.011.2

1905. Relation between wetting and electrical contact resistance between iron and mercury. KOBEL, E. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 326–30 (*Nov.*, 1948) *In German.*—The contact resistance between a clean polished Fe iron electrode and pure distilled Hg is in most cases 2–3 × that of the electrode and Hg together. Experiments described show that this resistance may be reduced to 1–3% of its value by wetting the iron Fe with the Hg. Bombardment with Mg atoms or ions enables this to be achieved. Wetting, after such treatment, persists only so long as the Fe surface remains beneath the Hg. The contact resistance is greatly dependent upon temp., almost vanishing at 300°C. This is attributed to the

loss of coherence of Hg with rising temp. Results of measurements are tabulated and plotted. A.

537.312.5

1906. A condenser method of investigating photo-voltaic force. RIVKIN, S. M. *J. Tech. Phys., USSR*, **18**, 1521–42 (*Dec.*, 1948) *In Russian.*—Investigation of crystal photoelectricity cannot give true information about the photo-voltaic force (p.v.f.) unless electron diffusion in the metallic electrodes can be eliminated or evaluated. An adaptation of a condenser method is described, and the theory of the method developed so that this diffusion effect may be eliminated. An approximate treatment is also given for non-stationary processes in semi-conductors during development of p.v.f. The conditions found for applicability of the condenser method for investigating p.v.f. is $RC \gg t_1 \gg \tau$ or $\tau \ll t_1 \ll \theta$ where R and C are the resistance and capacity of the condenser; t_1 time from incidence of illumination when observations are made; τ time from incidence of illumination when p.v.f. attains a stationary value and θ time from incidence of illumination when the diffusion effect attains its maximum value. Oscillographs indicate that the p.v.f. of semi-conductors τ is $\sim 10^{-3}$–10^{-5} sec. The temperature variation of the p.v.f. is investigated, and it is shown that the condenser method may be adapted for determining the sign of the photo-carriers. In all the cases investigated the signs for dark and light conduction are the same. W. H.

537.312.5 : 548.0 : 537

1907. Note on the photoconductivity of cadmium-sulphide crystals. FRERICHS, R. AND SIEGERT, A. J. F. *Phys. Rev.*, **74**, 1875 (*Dec.* 15, 1948).—The phenomenon of the photocurrent in CdS crystals being in excess of the total charge carried up to the conduction band by irradiating the crystals with light, or α, β, or γ-rays, is explained in that the incident radiation reduces the space charge set up by trapped electrons which enter the lowest empty level. At room temperature, changes in photocurrent occur instantaneously with variations, if any, in the incident radiation. This radiation controls the electron flow, the total effect being similar to the action of the grid in an amplifier tube. At very low temperatures a time delay is observable. W. S.

537.312.5 : 621.383

1908. Photo-electric amplifier with Sb–Cs cathode. FEINSTEIN, S. M. *J. Tech. Phys., USSR*, **18**, 39–48 (*Jan.*, 1948) *In Russian.*—The Sb–Cs cathode may be combined with the Cu–S–Cs emitter to form a single layer on the glass. A method of obtaining visible spectra of high sensitivity with a low dark current (on an average by 2–3 orders of magnitude < that of O–Cs cathode amplifiers) is described. The photo-electric properties of the cathode and the secondary-emission behaviour of the emitter in the stages of the amplifier were investigated. Specimens of small-stage (l.v. 350 V) amplifiers with Sb–Cs cathode and overall amplification $\sim 2 \times 10^2$ were developed. A.

537.312.5 : 621.383

1909. The efficiency of the barrier layer photo-cell. HOUSTOUN, R. A. *Phil. Mag.*, **39**, 902–10 (*Nov.*, 1948).—The variation of efficiency with wavelength was measured for 5 cells. The highest efficiency found for approx. monochromatic light was $6{\cdot}4 \times 10^{-8}$; the highest efficiencies recorded for white light were 2×10^{-6} and $6{\cdot}2 \times 10^{-5}$ for two arrangements. Photo-cells vary greatly in their efficiency. L. S. G.

537.312.5 : 621.383

1910. Structure and working characteristics of silver-sulphide photoelements. POTAPENKO, I. R. *J. Tech. Phys., USSR*, **18** (*No.* 11) 1356–68 (1948) *In Russian.*—Experimental evidence is put forward that rectifying as well as photoelectric properties of Ag_2S photoelements are connected with the presence of a barrier layer of a few Å thickness in their structure. The properties and behaviour of this layer in varying conditions were investigated by modulated light and a.c. bridge methods. A.

537.312.5 : 621.383

1911. Physical characteristics of silver sulphide photo-elements. KOSENKO, V. E. AND MISELYUK, E. G. *J. Tech. Phys., USSR*, **18** (*No.* 11) 1369–77 (1948) *In Russian.*—Basic advantages: (*a*) high integral sensitivity over a very wide range of the spectrum, (*b*) high sensitivity in the red and near infrared, with a maximum at $\sim 0{\cdot}8$–$0{\cdot}9\ \mu$ and a red limit at $\sim 1{\cdot}4\ \mu$, (*c*) stable spectral characteristic, independent of the parameters of the photo-elements, (*d*) long life-time (< several years). Basic disadvantages: (*a*) the range of linear relation between photocurrent and illumination (with an accuracy of $\sim 1{\cdot}5\%$) is confined to medium values of illumination, i.e. 100–200 lux (for s.c. photocurrent), (*b*) relatively low internal resistance, (*c*) appreciable inertia, (*d*) appreciable temperature coefficient. B. F. K.

537.312.5 : 621.383.4

1912. Frequency characteristic of lead sulphide photo-resistors. KOLOMIETS, B. T. Letter in *J. Tech. Phys., USSR*, **18** (*No.* 11) 1456–7 (1948) *In Russian.*—The following data are provided: (1) Internal resistance 0·03–3 MΩ. (2) Integral sensitivity in a field of 470 V/cm, 40 mA/1m or 0·835 A/W at a colour temp. of the light source of 2 848°K and illumination 100 lux. (3) Spectral sensitivity max. at $2{\cdot}5\ \mu$, red limit at $3{\cdot}5\ \mu$. The sensitivity extends over the whole visual range, falling to $\sim 10\%$ of the max. at $0{\cdot}4\ \mu$. The frequency characteristics plotted in the range up to 10^4 c/s fall smoothly from 100% response at zero frequency to 70% at 10^4 c/s. B. F. K.

537.312.6

1913. Temperature variation of resistivity of ferro-magnetic MnSb. MANNEVY-TASSY, G. *C.R. Acad. Sci., Paris*, **226**, 1592–3 (*May* 19, 1948) *In French.*—The alloy MnSb has a Curie point at ~ 300°C and behaves normally up to this temperature. Above 450°C variation of resistivity with temperature becomes irreversible and the curve falls below the rising curve with diminishing temperature. An abrupt rise at 620°C is noted. No discussion is given. N. F. A.

537.312.62

1914. Critical field measurements on superconducting tin foils. ANDREW, E. R. *Proc. Phys. Soc., Lond. A*, **62**, 82–95 (*Feb.* 1, 1949).—The critical fields of superconducting Sn foils have been determined from resistance measurements in a longitudinal magnetic

field. Pomeranchuk's relation, $H_f = H_c(1 + \lambda'/d)$, between the foil critical field H_f and the foil thickness d was verified, and values of the length λ' were found as a function of temp.; at 0°K the value of λ' was estimated to be $1{\cdot}2 \times 10^{-5}$ cm, rising rapidly close to the transition temperature. It is noticed that λ' is $\sim 2\times$ the penetration depth λ for Sn at all temperatures. Assuming the validity of Ginsburg's interpretation of λ' as the sum of λ and the surface energy parameter β, it is seen that λ and β are approximately equal. A.

537.312.62 : 535.23.08

Behavior of a superconducting bolometer in its transition region. *See Abstr.* 1783

537.312.62 : 536.48

1915. A wave-mechanical model of the superconductor. WELKER, H. *Z. Naturforsch.*, **3a**, 461–9 (*Aug.–Nov.*, 1948) *In German.*—The author constructs hypothetical wave functions for the purpose of illustrating the type of electron interaction which may lead to superconductivity. These wave functions are degenerate and magnetic interaction produces an energy gap. A qualitative explanation of superconductivity analogous to Bethe's theory of superstructure is given. It is essential for the model that the superconductor should be a mixed conductor, as defect electrons are used to build up the hypothetical wave function. Another consequence of the types of electron interaction assumed is a range of electron densities within which superconduction is possible. This is verified by comparison with the range of atomic values occupied by the known superconductors. The maximum electron density is, however, not in agreement with the theoretical prediction. Some conclusions concerning the lattice structure of superconductors are indicated. H. MO.

537.312.8 : 538.639

Variation of resistance in magnetic field. *See Abstr.* 2035–6

537.312.9 : 621.3.011.2

1916. Electrical resistance of wires with large strains. WEIBULL, W. Letter in *Nature, Lond.*, **162**, 966–7 (*Dec.* 18, 1948).—The linearity of the electrical resistance of wires of certain alloys with strain can be explained as a mainly geometrical effect, if the resistivity of the material, and its volume, are assumed unchanged by the straining. This theory agrees closely with experimental results on a Cu–Ni alloy, for which experiments also show that the *rate* of straining does not affect the linear relationship—a result which agrees with the geometrical explanation. A. J. K.

537.321 : 538.639

1917. Influence of magnetization on the thermoelectric power of magnetic materials. BOUCHARD, J. *C.R. Acad. Sci., Paris*, **226**, 1708–10 (*May* 24, 1948) *In French.*—Measurements of the thermoelectric power of a couple composed of a Cu wire and a wire of steel or Ni alloy were made at different temperatures, and showed a discontinuity at the Curie point. Similar measurements were also made on a couple containing two wires of the same material, one magnetized, the other not. A. E. DE B.

ELECTRIC DISCHARGES 537.52

537.52

1918. Investigation of the variation of the intensity of the independent current in a gas. GALKINA, S. P. AND GRANOVSKI, V. L. *J. Tech. Phys., USSR*, **18**, 585–600 (*May*, 1948) *In Russian.*—Low pressure tests on Hg vapour arc discharges established that increase of current requires a temporary voltage rise, and reduction of current a temporary decrease of the voltage in the discharge path, considered as an unchanging gaseous medium. If the current variation is produced by a rapid (i.e. $< 10^{-7}$ sec) change of the resistance in the discharge circuit, then the temporary rise (or fall) of the voltage presents a sharp peak with steep front and smoother descent. The drop period from the peak value of the voltage, i.e. the time taken for establishing a new equilibrium, $\sim 10^{-5}$ sec, and depends on the gas density; it coincides exactly with the duration of the recovery processes in the discharge, as previously determined by the method of small excitations. At slow rates of action on the discharge (10^{-3} sec and more) the voltage peak becomes insignificant. The results show that in an unaltering gaseous medium, as in any other medium, the voltage variation in the discharge path is the primary cause of the current variation along it. B. F. K.

537.52

1919. Electronic interaction in electrical discharges in gases. CAHN, J. H. *Phys. Rev.*, **75**, 293–300 (*Jan.* 15, 1949).—The Boltzmann transfer equation has been solved for the case of high current densities and low field strengths where electrostatic interactions may not be neglected. The solution has been examined for two different electron-molecule cross-sections for momentum transfer. In one, the cross-section varies inversely with electron velocity, and the distribution is found to be Maxwellian at all electron densities. In the other, the cross-section is assumed independent of the electron energy. On the latter assumption, the solution varies from the Davydov distribution at low electron densities to the Maxwellian distribution at high densities. Curves have been drawn showing the transition of the distribution as the density increases. The corresponding values of average energy, drift velocity, and average velocity have been tabulated. A.

537.52 : 537.226.2

1920. On the dielectric properties of a gas discharge. SALPETER, E. E. AND MAKINSON, R. E. B. *Proc. Phys. Soc., Lond. B*, **62**, 180–8 (*March* 1, 1949).—Formal expressions are derived for the space currents and electrode currents produced by a sinusoidal potential difference of angular frequency ω applied between a pair of electrodes at a distance d apart and immersed in a gas discharge. It is shown that the ionized gas behaves like an isotropic medium of dielectric constant $\{1 - 4\pi ne^2/m\omega^2\}$ and zero conductivity only in the limiting case of $\beta \equiv v/\omega d \ll 1$ where v is the r.m.s. velocity of the free electrons in the gas. The variation of the equivalent dielectric constant and conductivity of the gas with β are sketched. Extensions of Green's reciprocation theorem and of a theorem on induced currents given by W. Shockley are derived in the appendix. A.

537.52 : 537.56

1921. Electron energies resulting from an electric field in a highly ionized gas. GIOVANELLI, R. G. *Phil. Mag.*, **40**, 206–14 (*Feb.*, 1949).—It is shown that as the electric field applied to a gas is increased the discharge current, which is initially limited by elastic collisions between electrons and positive ions, increases rapidly as the field strength reaches a critical value. This is caused by a reduction in the cross-section of positive ions for scattering of electrons with increasing electron velocity. The variation of the electrical conductivity with field strength and the critical value of the latter for a discharge are discussed. No allowance is made for the distribution of energies and free paths. The results are applied to the sun's atmosphere, which is highly ionized. The conductivity is estimated both for weak fields and when electron velocities are limited by inelastic collisions. L. S. G.

537.523 : 621.315.618.015.5

1922. Electrical breakdown of a gas between coaxial cylinders at microwave frequencies. HERLIN, M. A. AND BROWN, S. C. *Phys. Rev.*, **74**, 910–13 (*Oct.* 15, 1948).—The criterion for breakdown of a low pressure gas at microwave frequencies is that the ionization rate equals the diffusion rate for electrons. This principle is applied to compute the breakdown of air in coaxial cylinders using data obtained from breakdown experiments between parallel plates [Abstr. 3775 (1948)]. Agreement between computed and measured results at 9·6 cm supports the above criterion. The method is illustrative of the general problem of computing breakdown fields for tubes of arbitrary shape and field configuration using ionization coefficient data obtained from uniform field breakdown. A.

537.523.4 : 621.316.933.1

1923. Delay of spark discharge in long gaps. II. BAK, M. A., SINGERMANN, A. S. AND NIKOLAEVSKAYA, N. N. *J. Tech. Phys., USSR*, **17**, 1153–8 (*Oct.*, 1947) *In Russian.*—An investigation was carried out on the effect of the length of rod gaps over the 10–30 cm range with a positive rectangular and infinite wave on the parameters of the distribution function of spark discharge delay. On the basis of figures obtained on 2 000 oscillograms, a formula is developed relating the mean operating period and mean deviation to the gap length and voltage. E. R. A.

537.525

1924. Production of Joshi-effect in bromine vapour under silent electric discharge. DESHMUKH, G. S. AND SIRSIKAR, S. *J. Amer. Chem. Soc.*, **70**, 3924–8 (*Nov.*, 1948).—Production of Joshi Effect in bromine vapour has been studied from 5° to 75°C. At any temperature Δi increases with applied potential, V, except for large values of V. Results are in accord with Joshi's theory which considers that Δi originates from an activated, adsorption-like, wall layer formed with ions and molecules of the gas and that light releases photo-electrons from this layer. These photo-electrons are captured by excited atoms to form slow negative ions and bring about the decrease, Δi, as a space charge effect. W. R. A.

537.525.5

1925. On the possibility of Hg type arcs with hot refractory cathodes. ROTHSTEIN, J. Letter in *J. Appl. Phys.*, **19**, 1181–2 (*Dec.*, 1948).—Suggests the possibility of a discontinuous glow/arc transition (c.f. the continuous transition obtained with thermionic arcs) involving the formation of vapour clouds from and near the cathode. The suggestion is made primarily for Hg cathodes but, it is thought, might arise with W cathodes of very small area. J. D. C.

537.525.9 : 537.562

1926. Plasma-electron oscillations. NEILL, T. R. Letter in *Nature, Lond.*, **163**, 59–60 (*Jan.* 8, 1949).—Describes experiments made with a special tube incorporating a straight filament and movable probes (Hg vap., at room temp.) coupled to external co-axial resonators. The plasma oscillations appear to be maintained by an analogous mechanism to that operative in h.f. oscillations caused by electron transit time effects in hard diodes. J. D. C.

X-RAYS 537.531

537.531 : 535.33

1927. Erratum: "A solid state interpretation of the structure near the limit of the continuous X-ray spectrum." DUMOND, J. W. M. Letter in *Phys. Rev.*, **74**, 1883 (*Dec.* 15, 1948).—An error, involving a factor of 10^{-3}, in the energy lost by a fast electron invalidates the conclusion about the appearance of the Ohlin valleys and the reversals of slopes in the low voltage isochromats [see Abstr. 3214 (1947)]. The author now adheres to the explanation given by Nijboer [see Abstr. 636 (1947)]. G. O. B.

537.531 : 535.34

1928. The absorption coefficient at the long wave limit of the continuous X-ray spectrum. ELWERT, G. *Z. Naturforsch.*, **3a**, 477–81 (*Aug.–Nov.*, 1948) *In German.*—A formula for the absorption coefficient is derived. The formula found by Kramers by means of the correspondence principle [Abstr. 863 (1924)] is a limiting case of the author's formula when $\alpha Z/\beta \gg 1$ where α is the fine structure constant, Z the nuclear charge and $\beta = v/c$, while $\frac{1}{2} r \alpha Z/\beta \ll 1$ and r is the ratio of frequency and limit frequency. Gaunt's wave mechanical formula [Abstr. 3409 (1930)] on the other hand is found for $\alpha Z/\beta \ll 1$. H. MO.

537.531 : 535.4 : 537.533.73

1929. Optical analogue of X-ray and electron diffraction patterns. RAMACHANDRAN, G. N. Letter in *Nature, Lond.*, **163**, 24–5 (*Jan.* 1, 1949).—The phenomena described by Dyson [Abstr. 4032 (1948)] had already been demonstrated by Kathavate [Abstr. 1869 (1946)]. A. J. C. W.

537.531 : 535.43

1930. A method for measuring the total power of small-angle X-ray scattering. WARREN, B. E. *J. Appl. Phys.*, **20**, 96–7 (*Jan.*, 1949).—Measurements of the absorption coeffs. are made with a double crystal spectrometer in the parallel position, placing the sample between the two crystals, and between the second crystal and the chamber. In the first position

the beam is cut down by the ordinary absorption and also by the power going into small-angle scattering; in the second position it is cut down only by the ordinary absorption. The difference in the two measured absorption coeffs. gives directly the total power in small-angle scattering. From the latter, an average spherical particle size can be computed. A.

537.531 : 535.43

1931. Scattering of X-rays by the *L* electrons of boron. ALEXOPOULOS, K. AND SCOULOUDI, H. *Phil. Mag.*, **40**, 115–23 (*Jan.*, 1949).—The intensity was measured at various angles. A monochromatic beam was obtained by the bent crystal method of reflection. The intensity of the scattered rays was measured in a scattering chamber of the Seemann–Bohlin type by the photographic method. A comparison of the results with the theoretical curves calculated for the case of 0, 1, and 3 free electrons per atom shows that the experimental curve agrees best with the theoretical curve in the case of no free electrons. A.

537.531 : 535.43 : 539.215.4

Particle size determination by soft X-ray scattering. *See Abstr.* 2138

537.531 : 535.43 : 541.18

1932. The dependence of the X-ray small-angle scatter on shape and size of colloidal particles in dilute systems. III. KRATKY, O. AND POROD, G. *Acta Phys. Austriaca*, **2** (*No.* 2) 133–47 (1948) *In German.*—The influence of the shape of particles on small angle X-ray scatter, as first derived by Guinier, is discussed on the basis of Debye's theory of X-ray scatter by gas molecules. If the system is built up of rows of spheres or of discs made up of spheres, it is shown that the scatter of particles deviates considerably from a Gaussian distribution. From this deviation conclusions are drawn as to the shape and size of particles. A more accurate approach to the determination of shape can be made from the computation of scatter by assuming that the systems are built up of ellipsoids, cylinders and parallelepipeds. R. H. H.

537.531 : 539.152.1

1933. Radiative X-ray transition within the *L*-shell of sulphur. TOMBOULIAN, D. H. Letter in *Phys. Rev.*, **74**, 1887 (*Dec.* 15, 1948).—The $L_{I} \rightarrow L_{II-III}$ line of S was detected at $\lambda = 203$ Å. Its width is 1·5 eV. This confirms the importance for light elements of radiative processes within the *L*-shell. L. P.

537.531 : 539.167 : 539.16.08

Investigation of soft radiations by counter. *See Abstr.* 2059

537.531 : 621.385.15.08 : 548.73

Electron multiplier tubes in the measurement of X-ray beam intensities. *See Abstr.* 2206

CATHODE RAYS

POSITIVE RAYS 537.533/.534

537.533.7 : 621.384.6

1934. A fifteen inch glass betatron toroid. RUSHFORTH, L., MORRISON, S. J. AND BRETT, J. G. *BTH-Activ.*, **19**, 357–62 (*July–Aug.*, 1948).—Describes in detail the manufacture of single-piece glass toroidal vacuum chambers for a 20 MeV betatron. The chambers are built up from 2 trough-shaped pieces which are sealed together round their peripheries. The processes of sealing the chamber and, later, the 4 side arms are described in detail. J. D. C.

537.533.7 : 621.384.6

1935. A travelling-wave linear accelerator for 4 MeV electrons. FRY, D. W., R-S-HARVIE, R. B., MULLETT, L. B. AND WALKINSHAW, W. *Nature, Lond.*, **162**, 859–61 (*Nov.* 27, 1948).—The operation of the type of accelerator described [Abstr. 3120 B (1947)] but extended to a length of 2 m is described. Input power of 2 MW peak in the best conditions transferred 0·6 MW peak to electrons accelerated to near 4 MeV, the ohmic loss including the feeds still being only 2·5 db. A spot about 7 mm diameter on a Pb target was obtained giving a max. of 30 roentgen/min for input pulses of 2 μsec at 50 per sec or 132 r/min at 200 per sec. J. H. F.

537.533.72 : 621.385.8

1936. An optical bench for electron optical studies. REISNER, J. H. AND PICARD, R. G. *Rev. Sci. Instrum.*, **19**, 556–60 (*Sept.*, 1948).—An evacuated chamber containing a heavy lathe bed for supporting and aligning optical parts, and means for moving the essential internal components from the exterior, is described. The construction is explained in detail. Stabilized h.v. to 30 kV and stabilized l.v. supplies for energizing electromagnetic lens coils are provided. The equipment may be used to illustrate the operation of c.r.t., electron microscope and diffraction apparatus, or to study the properties of phosphors and optical components such as lenses, guns and deflection electrodes. A.

537.533.72 : 539.165.08

1937. The focusing of β-rays in a prolate spheroidal magnetic field. RICHARDSON, H. O. W. *Phil. Mag.*, **40**, 233–44 (*Feb.*, 1949).—The applicability to β-ray spectroscopy of the magnetic field between pole-faces which are hyperboloids of revolution is discussed. Trajectories of particles emitted from points on the axis of symmetry are computed by numerical integration of the relativistic equations of motion. The rays cross over at two successive sites in the meridional plane of which the second could be arranged to lie close to the axis. The attainable resolving power seems to be similar to that of the semicircular spectrograph, while the solid angle of collection can be made as large as 8·5% of 4 π. A.

537.533.72 : 621.385.833

1938. The theoretical resolution limit of the electron microscope. SCHERZER, O. *J. Appl. Phys.*, **20**, 20–8 (*Jan.*, 1949).—Resolving power and image contrast are calculated for different conditions of focusing, illumination and aperture. These conditions can change the limit of resolution by a factor of ~3. The contrast in the image of an atom is appreciably increased by defocusing and spherical aberration. Nevertheless, the contrast improves when the numerical value of the aberration constant is diminished. The effect of different methods of spherical correction is discussed briefly. A.

537.533.72 : 621.385.833

1939. Aberration correction with electron mirrors. RAMBERG, E. G. *J. Appl. Phys.*, **20**, 184–6 (*Feb.*, 1949).—Both the spherical and the chromatic aberration of electron microscope objectives may, in principle, be corrected with the aid of a uniform retarding field acting as a mirror. Such an arrangement has the drawback of requiring a conducting film in the ray path and the insertion of the specimen in a region of high field strength. The employment of concave electron mirrors with concentrated field distribution, forming a real image of approximately unity magnification, is free from this drawback. The formulae for spherical and chromatic aberration, presented in a form suitable for calculation, are applied to a characteristic electron mirror field of this type ($\Phi = C + \tanh(\sinh z)$). It is found that the aberration coefficients of the mirror are so large, however, that this method of aberration correction encounters serious practical difficulties. A.

537.533.73 : 535.4 : 537.531

Optical analogue of electron diffraction patterns. *See Abstr.* 1929

537.533.73 : 621.385.833

1940. Notes on electron diffraction with the universal electron miscroscope. DUNAWAY, R. E. AND BARTON, H. M. *J. Appl. Phys.*, **19**, 799–800 (*Aug.*, 1948).—Describes an arrangement whereby a specimen may be observed successively by electron microscopy and electron diffraction with an effectively larger plate-to-specimen distance. After use as a microscope the pole-pieces are removed and realignment is necessary. H. H. HOP.

537.533.8 : 621.383

1941. Photoelectric multipliers. RODDA, S. *J. Sci. Instrum. Phys. Ind.*, **26**, 65–70 (*March*, 1949).—A review of operation, theory, and applications. 23 references. A.

537.533.92 : 539.165

1942. Specific ionization of fast β-particles in a mixture of air and ethyl alcohol-water vapour. BEEKMAN, W. J. Letter in *Nature, Lond.*, **163**, 167–8 (*Jan.* 29, 1949).—Draws attention to a discrepancy between the author's previous work [Abstr. 893 (1947)] and recent work by Curran and Reid [Abstr. 1051 (1948)]. B. R.

537.534 : 536.62

1943. A calorimeter for the determination of the intensity of a beam of accelerated particles. SANDERS, J. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 36–8 (*Feb.*, 1949).—The construction of a target which allows the measurement of the energy in a beam of accelerated particles is described. From this may be deduced the number of particles in the beam. The calorimeter is useful in cases where the charge collected is not a significant measure of this quantity. The accuracy obtainable is better than 2%, and the power handling capacity 25 W. The latter is capable of extension over a wide range. A.

537.534 : 537.133

1944. High frequency proton source. HALL, R. N. *Rev. Sci. Instrum.*, **19**, 905–10 (*Dec.*, 1948).—A proton source employing a 450 Mc/s electrodeless discharge in the presence of a magnetic field is described. Ion currents of 400 μA, consisting of over 60% protons, are normally obtained, corresponding to a current density due to focused and analysed protons of 0·03 A/cm² at the 1 mm exit hole. The source requires a H flow of 30 cm³/hr, most of which is prevented from entering the accelerating column by the use of a differential pumping arrangement. The ions diffuse out through the exit hole and are accelerated without the use of a probe, resulting in a well focused, monoenergetic beam accompanied by relatively few stray ions. The experimental results were obtained on a 120 kV accelerator designed to simulate the initial sections of a typical constant voltage accelerator. A.

537.534 : 537.291 : 539.17

Absolute voltage determination of nuclear reactions. *See Abstr.* 2102

537.534 : 539.155.2

1945. The production of intense ion beams in a mass spectrometer. BERNAS, R. H. AND NIER, A. O. *Rev. Sci. Instrum.*, **19**, 895–9 (*Dec.*, 1948).—A simple 60° mass spectrometer has been built for the production of intense ion beams. Ions are produced by allowing an electron beam collimated by a transverse magnetic field to bombard the vapour issuing from a furnace. By adjusting conditions properly an arc may be struck and total ion currents of 1–2 mA could be obtained from the source when the accelerating voltage applied was 15 keV. The collected isotopes were completely resolved, and a total current of 0·3 mA for the several isotopes at the final collector was observed. Because of gas focusing at the operating pressure, space charge effects did not seriously affect the resolution and a resolving power of 1/100 could be obtained. In a 14 hr run 6·5 mg of separated Zn isotopes were collected. Preliminary results with Mg, as well as other solids, indicated that many other substances could be separated without modifying the apparatus. Improvements which would permit higher yields are suggested. A.

537.534 : 539.181

Rate of energy loss for slow H^1, H^2, He^4, Li^6 nuclei in Au and Al. *See Abstr.* 2128

537.534 : 621.384.6

1946. The design of linear accelerators. SLATER, J. C. *Rev. Mod. Phys.*, **20**, 473–518 (*July*, 1948).—A critical comparison of linear accelerators with other high-energy particle accelerators. Properties of the electromagnetic fields in resonant and in travelling-wave systems are analysed. Efficiency, impedance properties and power requirements of various systems are examined, with special consideration of the M.I.T. π-mode electron-tube. The tolerances necessary are discussed, and the dynamics of particle behaviour are analysed. J. H. F.

537.534 : 621.384.6

1947. A 600 kV ion accelerator. JELLEY, J. V. AND PAUL, E. B. *Can. J. Res. F*, **26**, 419–25 (*Oct.*, 1948).—The 600 kV ion acceleration equipment developed at the Ottawa Laboratory of the National Research Council is described. Details of ion source, power column, and control gear are given. Using H a total ion beam of 250–300 μA was obtained, of which ~ 80% was atomic ions. A.

537.534 : 621.384.6

1948. Azimuthal variations of the betatron field. LASICH, W. B., MUIRHEAD, E. G. AND WRIGHT, I. F. *J. Sci. Instrum. Phys. Ind.*, **26**, 91–2 (*March*, 1949).—The azimuthal variations in the out-of-phase fields of a 3 MeV betatron have been measured using apparatus of improved sensitivity. The method is described and the out-of-phase field analysed giving the contributions from inhomogeneities in the iron, eddy currents between laminations and eddy currents in the laminations themselves. A structural steel clamping frame is shown to have a negligible effect on the field. A.

537.534 : 621.396.615.17 : 621.384.6

1949. High voltage pulser for 184 inch cyclotron electric deflector. KERNS, Q. A., BAKER, W. R., EDWARDS, R. F. AND FARLY, G. M. *Rev. Sci. Instrum.*, **19**, 899–904 (*Dec.*, 1948).—Describes a h.v. pulse generator developed to deflect the beam of the 184 in cyclotron at Berkeley, California. The apparatus develops a deflecting potential of 200 kV that rises from 10 to 90% of peak value in 0·1 μsec. The unit employs two similar 100 kV water-cooled pulse transformers connected symmetrically about earth to the electric deflector bars. Water-cooled pulse capacitors are discharged through the two turn primary windings of the pulse transformers by triggering a battery of 16 paralleled hydrogen thyratrons. Output voltages are developed across the 17-turn secondary winding of the pulse transformer. The transformer is mounted in an oil-filled Lucite case that provides both insulation and compact design. A.

537.534.72

1950. The electrostatic analysis of ionic beams. YARNOLD, G. D. AND BOLTON, H. C. *J. Sci. Instrum. Phys. Ind.*, **26**, 38–40 (*Feb.*, 1949).—An apparatus is described for the separation of an ionic beam into discrete energy groups, by means of a uniform electric field into which the beam is directed for maximum range. A.

537.534.74 : 537.13

1951. Energy straggling of protons. MADSEN, C. B. AND VENKATESWARLU, P. *Phys. Rev.*, **74**, 1782–4 (*Dec.* 15, 1948).—The energy straggling of protons of different energies penetrating foils of mica or Be of different thicknesses has been measured using the resonance radiation from Al and F targets as energy indicators. The experimental results are in good agreement with the theory of straggling. A.

DISCHARGE TUBES : COUNTERS 537.54

537.54

1952. High frequency counter as indicator of light ions. PROKOFIEF, A. M. *J. Tech. Phys., USSR*, **18**, 601–2 (*May*, 1948) *In Russian.*—In previous papers a high-frequency ion counter had been described [Abstr. 4648 (1937)]. The present note shows that the high-frequency flashes or impulses are excited by light air ions of mobilities $\geqslant 0{\cdot}47$ cm²/V sec. B. F. K.

537.542

1953. Two methods of measurement of dead time in Geiger–Müller counters. PUTMAN, J. L. AND COOKE-YARBOROUGH, E. H. *J. Sci. Instrum. Phys. Ind.*, **25**, 409–11 (*Dec.*, 1948).—The insensitive period following a count in a Geiger counter is measured by two methods. Each relates only to the periods following fully recovered pulses. The first method is an extension of the oscillograph method of Trost [Abstr. 3210 (1937)] and of Ruark and Branmer [Abstr. 4152 (1937)]. A pulse interval discriminator is described which triggers the oscilloscope only when the counter is in a fully recovered state. This method is accurate for measurements of the dead time of a counter associated with a given recording circuit. By the second method, the time of recovery to any preselected fraction of the full pulse amplitude is measured. This is done by means of an electronic gate which automatically sets its length equal to the recovery time. This period is displayed on a meter. A.

537.542

1954. On the life of self-quenching counters. FRIEDLAND, S. S. *Phys. Rev.*, **74**, 898–901 (*Oct.* 15, 1948).—A Geiger–Müller counter filled with argon and ethyl acetate was connected to a mass spectrometer, and spectra were obtained after predetermined numbers of counts. Results showed that factors influencing the life of the counter were the disappearance of the quenching vapour and the formation of non-quenching vapours. An argon-methane counter, studied by the same method, showed that contamination of the insides of the counter, by the dissociation products, limited its life. This process occurred before any appreciable fraction of the methane was consumed. A.

537.542

1955. A study of the deterioration of methane-filled Geiger–Müller counters. FARMER, E. C. AND BROWN, S. C. *Phys. Rev.*, **74**, 902–5 (*Oct.* 15, 1948).—The changes in the characteristics of methane-filled Geiger–Müller counters were studied as a function of counter life. It was found that the counters had a useful life of between 10^7 and 10^8 counts. Mass-spectroscopic analysis of the gas during the life of the counter showed the major decomposition products in the gaseous phase to be hydrogen, ethane, ethylene and acetylene. These changes in gas composition did not account for the counter deterioration. The heavy hydrocarbon products deposited on the electrodes resulted in counter failure. A.

537.542

1956. Starting potential of the Geiger–Mueller counter discharge. WEISZ, P. B. *Phys. Rev.*, **74**, 1807–12 (*Dec.* 15, 1948).—The starting voltage for the pulse-equalizing G–M tube discharge has been measured for mixtures of A and hydrocarbons, and He and hydrocarbons. The results are discussed in the light of the known ionization potentials of the homologous series of normal hydrocarbons and the energy levels of the phenomena which contribute directly (by ionization), or indirectly (by metastable intermediates), to the production of the ions in the initial process. A

537.542 : 535.376

1957. Temperature dependence of scintillations in sodium iodide crystals. ELMORE, W. C. AND HOFSTADTER, R. Letter in *Phys. Rev.*, **75**, 203–4 (*Jan.* 1, 1949).—Scintillations from activated NaI, detected by a photomultiplier, were displayed on a high speed oscillograph. The quanta detected were probably too few to smooth statistically into recognizable pulse shapes. The pulse duration, from room temp. to 345°C, varied from $\sim 0{\cdot}5$ μsec to $0{\cdot}15$ μsec. The amount of light detected varied inversely in about the same ratio. L. E. M.

537.542 : 535.376

1958. Relative sensitivities of some organic compounds for scintillation counters. GITTINGS, H. T., TASCHEK, R. F., RONZIO, A. R., JONES, E. AND MASILUN, W. J. Letter in *Phys. Rev.*, **75**, 205–6 (*Jan.* 1, 1949).—9 compounds were tested as scintillation counters: stilbene, anthracene and naphthalene being best in that order. For these compounds, but not the others tested, most of the β-rays generated made enough photons to be counted. The connection between scintillation counting and other properties of the compounds is discussed. L. E. M.

537.542 : 539.16.08

1959. A proportional counter of spherical form. SALVINI, G. Letter in *Ric. Sci.*, **18**, 415 (*March–April*, 1948) *In Italian.*—A spherically shaped proportional counter made entirely of metal is described. U. C.

537.542 : 539.164.08

1960. Alpha particle counter for use with radioactive gases. YOVANOVITCH, D. K. AND YOVANOVITCH, D. D. *C.R. Acad. Sci., Paris*, **226**, 1718–20 (*May* 24, 1948) *In French.*—Three circular wire electrodes, two at the same potential, are used. The α-particles enter the counting volume through the thin walls of an axial glass tube along which the active gas is caused to flow. R. W. P.

IONIZATION . THERMIONICS 537.56/.58

537.56 : 537.52

Electron energies in a highly ionized gas. *See Abstr.* 1921

537.58

1961. The problem of the ionisation of atoms and neutralization of the ions on the surface of a semiconducting cathode. MORGULIS, N. D. *J. Tech. Phys., USSR*, **18**, 567–72 (*May*, 1948) *In Russian.*—Further development of former work [e.g. *J. Exp. Theor. Phys.*, **16**, 959 (1946); *J. Tech. Phys., USSR*, **17**, 983 (1947)] on phenomena connected with semi-conducting cathodes. The peculiarities of the surface phenomena are pointed out and contrasted with their equivalent for metal surfaces. Approx. relations are given for the probability of the processes considered and it is shown that they permit of an interpretation of experimental data. B. F. K.

537.58 : 621.385.032.216

1962. Resistance of oxide cathode coatings for high values of pulsed emission. DANFORTH, W. E. AND GOLDWATER, D. L. *J. Appl. Phys.*, **20**, 163–73 (*Feb.*, 1949).—Measurements are described of the potential variation of fine ribbon probes embedded in standard Ba and Sr oxide coatings. Observations were made with 19 tubes at values of pulsed emission of 50 A/cm². Results were: (*a*) resistances (*R*) were ranged from 2 to 230 Ωcm²; (*b*) potential gradients were adequate to admit dielectric breakdown as a cause of sparking; (*c*) the curve of *R v.* emission passes through a max. and, at different temps., this max. occurs at the same probe potential; (*d*) with BaO or mixed cathodes of higher values of *R*, the *R* is largely at the interface: for low *R* coatings no observations on this matter were obtained; (*e*) the best two tubes as regards high emission without sparking had the lowest values of *R*; (*f*) the *R* of SrO cathodes is an order of magnitude > that of BaO or mixed cathodes; (*g*) superposition of d.c. upon pulsed emission gives a pronounced decrease of *R*. A.

537.58 : 621.385.032.216

1963. Work functions and conductivity of oxide-coated cathodes. MAHLMAN, G. W. *J. Appl. Phys.*, **20**, 187–202 (*Feb.*, 1949).—The thermionic and photoelectric work functions and the temp. variation of coating conductivity have been measured for an oxide cathode. Thermionic and photoelectric currents were measured in both retarding and accelerating fields. The two work functions are found to be different, but not by the amount predicted by applying simple semi-conductor theory to the data. Photoelectric currents fit a Fowler plot over a limited range of frequencies. The large decrease in work function with applied field, the poor "saturation" of thermionic currents typical of oxide cathodes, and the behaviour of the photoelectric currents in accelerating fields all suggest a "patchy" surface. Applying "checkerboard" patch theory to the experimental data shows that most of the data is accounted for by assuming patches about 3×10^{-4} cm on a side differing in work function by about $0{\cdot}2$ V. A.

COSMIC RAYS 537.591

537.591

1964. Interpretation of cosmic-ray phenomena. ROSSI, B. *Rev. Mod. Phys.*, **20**, 537–83 (*July*, 1948).—The general description of the cosmic ray complex in the atmosphere is examined exhaustively and a consistent description is attempted: the treatment excludes the detailed geomagnetic effects and time variations and the specialized properties of large cascades. In particular, determinations of the numerical values of the main properties are collected and assessed critically. The results of rocket experiments beyond the atmosphere are summarized, and the broad features of the primary cosmic rays are discussed. J. G. W.

537.591

1965. On the variation with height of the intensity of nuclear evaporations in photographic plates. CORTINI, G., MANFREDINI, A. AND PERSANO, A. *Nuovo Cim.*, **5**, 292–8 (*Aug.*, 1948) *In Italian.*—Using photographic emulsions, a comparison is made between the number

of nuclear stars observed at 17 000 m and 3 500 m above sea level. The mean free path of the star-producing radiation is determined to be 140 gms/cm². U. C.

537.591

1966. On multiple processes in the hard component of the cosmic radiation. CLEMENTEL, E. AND DALLAPORTA, N. *Nuovo Cim.*, **5**, 298–310 (*Aug.*, 1948) *In Italian.*—The cross-sections, which have been calculated in a previous paper for multiple processes, are here applied to the proton and meson components of cosmic radiation. The value obtained for the penetration coefficient of the proton component and the variation (in intensity) of the component with height are in better agreement with experimental data than the results of the Heitler theory, which overlooks the possibility of multiple emission of mesons in the proton-proton collision. U. C.

537.591

1967. On the absorption in different materials of the star-producing radiation. BERNARDINI, G., CORTINI, G. AND MANFREDINI, A. Letter in *Nuovo Cim.*, **5**, 511–12 (*Oct.*, 1948) *In Italian.*—Using air, Al and Pb absorbers it is shown that the star-producing radiation is absorbed by nuclei in proportion to their geometrical cross-section. U. C.

537.591

1968. About the positive excess of the hard component of cosmic ray. QUERCIA, I. F., RISPOLI, B. AND SCIUTI, S. Letter in *Phys. Rev.*, **74**, 1728–9 (*Dec.* 1, 1948).—Measurements of the positive excess of cosmic ray particles have been made using a magnetic focusing system up to 7 000 m altitude. It is concluded that the positive excess decreases above 5 000 m altitude. J. G. W.

537.591 : 539.18

1969. On the generation of slow mesons. MORPURGO, G. *Nuovo Cim.*, **5**, 285–91 (*Aug.*, 1948) *In Italian.*—A comparison is made between the intensities of slow mesons measured by different observers at different heights, and the intensities of fast mesons at greater heights. It is shown that the local production of mesons stops at 4 000 m altitude. U. C.

537.591 : 539.18

1970. On cosmic ray mesons. PUPPI, G. Letter in *Nuovo Cim.*, **5**, 587–8 (*Dec.*, 1948) *In Italian.*—Assuming the μ-meson to be a heavy electron of spin $\frac{1}{2}$ and the π-meson to be responsible for nuclear interactions, the following factors are calculated: (*a*) The mean life-time of the π-meson. (*b*) The mean life for the nuclear absorption of a μ-meson from an extra-nuclear orbit. (*c*) The energy spectrum of the decay electrons from μ-mesons, assuming the μ-meson decays to a neutral meson, gamma ray and an electron. U. C.

537.591 : 539.18

1971. On the positive excess of the meson component at sea level under different zenithal angles. BALLARIO, C., BENINI, M. AND CALAMAI, G. Letter in *Phys. Rev.*, **74**, 1729–30 (*Dec.* 1, 1948).—The positive excess of cosmic ray particles at sea level is observed to decrease with increasing zenith angle, and it is suggested that the positive excess is energy-sensitive, decreasing with increasing initial energy of mesons, and that the process of meson formation shows a multiplicity increasing with primary energy. J. G. W.

537.591 : 539.18

1972. Energy of the disintegration product of a light mesotron. FLETCHER, J. C. AND FORSTER, H. K. Letter in *Phys. Rev.*, **75**, 204–5 (*Jan.* 1, 1949).—In a cloud chamber photograph in a magnetic field of μ-meson decay in a graphite plate the product of decay traverses another graphite plate 5 times with measurable energy loss, permitting an estimate of its mass. This particle is emitted with energy 36 ± 3 MeV and has 95% probability that its mass is $< 7\, m_0$. J. G. W.

537.591 : 539.18

Local generation of slow mesons by cosmic rays. *See Abstr.* 2126

537.591 : 539.18

1973. Observations with electron sensitive plates exposed to cosmic radiation. I. Decay of μ-mesons. BROWN, R., CAMERINI, U., FOWLER, P. H., MUIRHEAD, H., POWELL, C. F. AND RITSON, D. M. *Nature, Lond.*, **163**, 42–50 (*Jan.* 8, 1949).—Some observations on the processes in cosmic radiation made with the new Kodak electron-sensitive emulsions are described. These events include some examples of disintegrations produced by π^- particles and the β-decay of μ-mesons. In certain favourable cases, estimates of the energy of the decay product of the μ-meson have been made by studying its Coulomb scattering. In addition, a preliminary report is made of the observation of stars accompanied by showers of particles at minimum ionization. U. C.

537.591 : 539.18

1974. Observations with electron-sensitive plates exposed to cosmic radiation. II. Further evidence for the existence of unstable charged particles of mass $\sim 1\,000\, m_e$ and observations on their mode of decay. BROWN, R., CAMERINI, U., FOWLER, P. H., MUIRHEAD, H., POWELL, C. F. AND RITSON, D. M. *Nature, Lond.*, **163**, 82–7 (*Jan.* 15, 1949).—An event is described which offers further evidence for the existence of mesons of mass $>$ π-particles. A particle, of which the mass, as determined by grain counts, is $\sim 1\,000\, m_e$, comes to rest in the photographic emulsion and leads to the emission of three charged particles, one of which is apparently a π-meson. Evidence is given which suggests that the event corresponds to the spontaneous disintegration of the heavy particle into 3 charged mesons, whose masses are in the 200–300 m_e region. U. C.

537.591.08

1975. Exploratory cosmic ray observations at high altitudes by means of rockets. VAN ALLEN, J. A. *Sky and Telescope*, **7**, 171–5 (*May*, 1948).—A general discussion of the reasons for which rocket experiments are of importance and a survey of the results obtained by this technique. J. G. W.

537.591.15

1976. On an extension of the theory of low-energy showers. III. CLEMENTEL, E. AND FABBRICHESI, L. *Nuovo Cim.*, **5**, 78–85 (*April*, 1948) *In Italian.*—A further use is made of the results of two previous papers [Abstr. 1898 (1947), 994 (1948)] for evaluating the integral of the electron spectrum,

allowing for variability with energy of the cross-section for pair production, the Compton effect for photons, and the ionization energy losses of electrons. The spectrum is calculated for air and Pb. The modifications of the asymptotic shower theory for substances of high atomic number are seen to be mainly due to the variability of the cross-section for pair production, whereas for light elements the ionization effect, which accounts for a large electron absorption, substantially alters the distribution function. The results for Pb are compared with those obtained on the Bhabba–Chakrabarty theory (considering the ionization energy losses only). The variable cross-section for pair production causes a further decrease in the total electron production and displaces the distribution function towards larger thicknesses owing to the increased penetrating power.

537.591.15

1977. On the density distribution of extensive showers. DELLA CORTE, M. *Nuovo Cim.*, **5**, 93–7 (*April*, 1948) *In Italian.*—The number of showers in m^2 and minute with density between Δ and $\Delta + d\Delta$, i.e. the density distribution of extensive showers, has been shown to have the form $\nu(\Delta)d\Delta = K\Delta^{-\gamma}d\Delta$, where K and γ are constants. This expression has been compared with the results of an experiment carried out at sea level with counters in multiple coincidence and with the results of all measurements taken at sea level. From this comparison it seems that K is not constant but is a function of r, which is the smallest diameter of the showers capable of giving a coincidence. The density distribution is therefore $\nu(\Delta)d\Delta = 23r^{-0\cdot5}\Delta^{-2\cdot46}d\Delta$. This can be interpreted as showing the existence of air showers of small extension, which probably have a different origin from that of extensive showers. A.

537.591.15

1978. On the hypothesis of a new kind of particles in extensive showers. SALVINI, G. Letter in *Nuovo Cim.*, **5**, 104–6 (*April*, 1948) *In Italian.*—An analysis is made of the results of Auger and of other workers on the penetrating particles associated with extensive air showers. It is shown that the processes observed can be explained in terms of known particles, and that the existence of a heavy electron need not be assumed. U. C.

537.591.15

1979. Observations on large cosmic-ray bursts at an altitude of 3 500 meters. FAHY, E. F. AND SCHEIN, M. Letter in *Phys. Rev.*, **75**, 207–8 (*Jan.* 1, 1949).—Operation of a burst chamber enclosed in differing thick Pb shields was recorded on the same record as 4 independent unshielded shower counting arrays at 3 500 m altitude where the burst rate was 6·7× the sea-level rate. Less than 5% of bursts were accompanied by extensive showers; the variation from sea-level excludes high energy mesons as primaries, and variations of the Pb shield gave mean free path in Pb of 434 g/cm² as compared with the value 160 g/cm² accepted for nucleons. Evidence is given of strong collimation of the burst primaries about the vertical. J. G. W.

537.591.15

1980. The nature of penetrating particles in air showers. JÁNOSSY, L. AND MCCUSKER, C. B. A. *Nature, Lond.*, **163**, 181–3 (*Jan.* 29, 1949).—The frequency of penetrating events under 15 cm Pb associated with extensive air showers is shown to be reduced when a thin Pb roof is supported about 50 cm over the shielded system. A mass-equivalent brick roof at the same level has no appreciable effect. This result, together with the observed Z^2 dependence of formation of penetrating events in extensive showers, is interpreted in terms of charged particles somewhat heavier than electrons with a proper life of the order 10^{-11} second. J. G. W.

537.591.15 : 539.18

1981. On the presence of neutrons in extensive showers of cosmic rays. TONGIORGI, V. Letter in *Nuovo Cim.*, **5**, 101–3 (*April*, 1948) *In Italian.*—Evidence is offered for the existence of a neutron component in extensive air showers by a method employing delayed coincidences between extensive shower trays and BF_3 ionization chambers embedded in paraffin. U. C.

537.591.15 : 539.18

1982. On the origin of the neutrons associated with the extensive showers of cosmic radiation. TONGIORGI COCCONI, V. Letter in *Nuovo Cim.*, **5**, 391–3 (*Aug.* 1948) *In Italian.*—It is shown that the neutrons accompanying extensive air showers are produced by the penetrating component associated with these showers. U. C.

537.591.15 : 539.18

1983. Neutrons in the penetrating showers of the cosmic radiation. COCCONI, G., COCCONI-TONGIORGI V. AND GREISEN, K. *Phys. Rev.*, **74**, 1867–8 (*Dec.* 15, 1948).—Enriched B counters in a paraffin block were used to detect neutrons associated with local penetrating showers in Pb, Fe and C, the average number of neutrons produced in each material being deduced from the frequency with which two independent counter systems in the neutron detector operated in coincidence. The numbers of neutrons are about 30 in Pb, 18 in Fe and 10 in C, up to an energy of about 10 MeV. It is probable that more than one nucleus is involved in the evaporation leading to these neutrons. J. G. W.

537.591.3

1984. On the absorption of nucleonic component in cosmic rays. BERNARDINI, G., CORTINI, G. AND MANFREDINI, M. Letter in *Phys. Rev.*, **74**, 1878–9 (*Dec.* 15, 1948).—The absorption thickness of the star producing radiation was measured in air, Al and Pb and was found to correspond to a cross-section of the order $\frac{1}{2}$ to $\frac{1}{3}$ of the geometrical cross-section of the nucleus. The variation of star producing radiation in the atmosphere was also compared with the intensity of production of mesons. It was found that in the low atmosphere the meson formation increases less rapidly with altitude than the star producing radiation, but that at great heights (20 km) the reverse is true. It is concluded that the number of mesons formed increases strongly with decreasing meson energy. J. G. W.

537.591.5

1985. An investigation of the 27-day variation in cosmic radiation. GHERI, H. AND STEINMAURER, R. *Terr. Magn. Atmos. Elect.*, **52**, 343–56 (*Sept.*, 1947) *In*

German.—Observations of the hard component of cosmic radiation during 49 solar rotations exhibit on analysis a persistent wave whose amplitude agrees with that computed by Vallarta. The wave follows disturbances associated with the C.M.P. of giant sunspots, and shows a parallelism with magnetic storms. D. R. B.

537.591.8

1986. On the positive excess in cosmic radiation. Clementel, E. and Puppi, G. *Nuovo Cim.*, **5**, 529–34 (*Dec.*, 1948) *In Italian.*—The positive excess in cosmic radiation is considered in terms of a primary proton component, which produces multiple meson emission, and of the contribution due to the asymmetry between positive and negative mesons depending on the influence of the coulomb field of the parent nucleus on the diffused mesons. U. C.

537.591.8 : 539.17

1987. Cloud-chamber evidence of a meson-nucleus interaction. Valley, G. E., Leavitt, C. P. and Vitale, J. A. Letter in *Phys. Rev.*, **75**, 201–3 (*Jan.* 1, 1949).—Forked tracks have been obtained in a cloud chamber operating with A at 105 atm. in 8 800 gauss at 12 730 ft elevation which are interpreted as mesons giving rise by interaction with nuclei to short heavy tracks which are probably caused by protons. J. G. W.

MAGNETISM 538

538.082.102 : 538.214 : 538.224

1988. The determination of magnetic susceptibility by the Gouy method. Baddar, F. G., Hilal, O. M. M. and Sugden, S. *J. Chem. Soc.*, 132–5 (*Jan.*, 1949).—An apparatus is described for determining the magnetic susceptibility at room temperatures of pure liquids and solutions. It has been found capable of giving reproducible results with an accuracy of at least 1 part in 600 with diamagnetics. The following values have been found for $-10^6\chi$: water $0{\cdot}7200 \pm 0{\cdot}0002$, benzene $0{\cdot}7023 \pm 0{\cdot}0007$, acetone $0{\cdot}5806 \pm 0{\cdot}0008$. A.

538.082 : 621.317.49 : 620.179.14

1989. The testing of brass and other constructional materials for ferromagnetic impurities. Barker, J. R. *J. Sci. Instrum. Phys. Ind.*, **25**, 363–4 (*Oct.*, 1948).—A torsion balance magnetometer (with moving magnet and stationary specimen) is described; it is suitable for testing constructional materials for ferromagnetic impurities. The effects of specimen shape are discussed, and data relating iron content and magnetic permeability of brass are given. A.

538.1 : 530.1 : 525.24

Magnetic field of rotating bodies. *See Abstr.* 1676

538.114

1990. Theory of ferromagnetism of binary alloys. Vonsovski, S. V. *J. Tech. Phys., USSR*, **18** (*No.* 2) 131–44 (*Feb.*, 1948) *In Russian.*—A simple generalization of quantum theory of ferromagnetism on the binary ferromagnetic alloys is presented. The relation between the ferromagnetic Curie point of these alloys and the concentration of their components on one hand, and the degree of nearest order of the arrangement of their atoms with respect to the nodal points of the crystal lattice of the alloy, on the other hand. It is shown that at low temperatures there exists the same temperature-dependence of the spontaneous magnetization ($\sim T^{3/2}$) as in pure ferromagnetic metals. Bitter's quasi-classical theory of ferromagnetism is critically discussed. B. F. K.

538.114

1991. Discussion of the quantity σ_i occurring in ferromagnetic theory. Köster, W. *Z. Phys.*, **124** (*Nos* 7–12) 545–65 (1948) *In German.*—Becker's "stress" theory of ferromagnetism involves a quantity, σ_i, derived from the internal stress. When the crystal energy is negligible compared with the stress energy, σ_i has a unique significance, but when it becomes of comparable importance the effective value of σ_i depends on both energies and differs for different magnetic properties. Its value is worked out for the ΔE-effect, initial permeability, magneto-mechanical damping, stress-dependence of remanence and resistance and the form of the approach to saturation. It is shown that the variation of σ_i with temp. required to account for the observed effects of temp. on these properties can be explained by Kersten's "inclusion" theory which is thus complementary to the "stress" theory. C. E. W.

538.114 : 538.21

1992. On the theory of coercive force. Kersten, M. *Z. Phys.*, **124** (*Nos* 7–12) 714–41 (1948) *In German.*—A summary is given of the author's "inclusion theory" of coercive force and the surface energy and thickness of a 90° wall are calculated for cubic crystals with [100] easy directions of magnetization. These lead to improved estimates of the coercive force which is expressed in terms of the geometrical properties of the inclusions. The results confirm the earlier predictions of the theory. For particles $\geqslant$ the Block wall thickness, experimental results on Fe containing spherical particles of Fe_3C and on Fe–Ti alloys give measured values of coercive force $\sim$ those predicted by the theory. Suggestions for further work are given. A. E. De B.

538.114 : 538.566

1993. On the theory of ferromagnetic resonance. Polder, D. *Phil. Mag.*, **40**, 99–115 (*Jan.*, 1949).—Kittel's classical theory of resonance in a magnetized ferromagnetic material is generalized; a phenomenological theory is obtained in which the dependence on the shape and the dimensions of the specimen no longer occurs. As an application the propagation of a plane electromagnetic wave in a magnetized ferromagnetic medium is discussed. A quantum theory of the resonance phenomenon is given on the basis of a generalized Bloch spin wave theory. An ambiguity in the use of the term gyromagnetic ratio is pointed out. It is suggested that the anomalous g-value found by resonance experiments may be explained by the combined effect of an electric crystal field and spin-orbit interaction. A.

538.114 : 539.11

1994. The reality of some relations connecting interatomic distances and magnetic properties. Dorfmann, Y. G. *J. Tech. Phys., USSR*, **17**, 1215–18

(*Oct.*, 1947) *In Russian.*—Two relations given by Galperin [Abstr. 2953–4 (1947)] are critically considered. In the author's opinion these could not be derived from the available experimental data. A.

538.12

1995. Note on the field of a magnet immersed in a permeable medium. PAGE, L. *Phil. Mag.*, **39**, 846–7 (*Nov.*, 1948).—A reply to criticism by Livens [Abstr. 153 (1948)]. L. S. G.

538.12 : 537.226

1996. A note on minimum integrals in field theory. KILMISTER, C. W. AND CHIRGWIN, B. H. *Phil. Mag.*, **40**, 226–32 (*Feb.*, 1949).—A unification of the minimum energy theorems encountered in electromagnetic theory is stated and the extension to non-isotropic dielectrics and conductors is made. An application to the magnetic field suggests a modified form for the density of the magnetic force function, which agrees with Liven's expression [Abstr. 152 (1948)] for this quantity. A.

538.12 : 538.74

1997. Graphs of the induced magnetic moment and shielding effect of a spherical shell in a uniform magnetic field. TUCKERMAN, B. *Terr. Magn. Atmos. Elect.*, **52**, 369–73 (*Sept.*, 1947).—Calculated curves are given of the variation with permeability, for spherical shells of various thicknesses, of (i) the shielding effect (internal field/applied field), (ii) the ratio of the induced moment to that of a solid sphere of either infinite permeability or the same permeability as the shell. The graphs are applicable to screening problems and to the correction of quadrantal deviations of the magnetic compass. C. E. W.

538.214

1998. The magnetic susceptibilities of the rare-earth elements. I. Yttrium. HILAL, O. M. M. AND SUGDEN, S. *J. Chem. Soc.*, 135–6 (*Jan.*, 1949).—Y has been purified by fractional precipitation by ammonia carried in a current of air, and the process followed by magnetic susceptibility measurements. The limiting value found for $10^6\chi_Y$... is $0{\cdot}21 \pm 0{\cdot}02$. A.

538.214

1999. The magnetic susceptibilities of the rare-earth elements. II. Samarium. SUGDEN, S. AND TAILBY, S. R. *J. Chem. Soc.*, 136–7 (*Jan.*, 1949).—Sm has been purified by fractional crystallization of the double Mg nitrate in the presence of BiMg nitrate and the process has been followed by magnetic susceptibility measurements. The value found for $10^6\chi^{20°}_{Sm}$... is $6{\cdot}72 \pm 0{\cdot}03$. A.

538.214

2000. The magnetic susceptibilities of the rare-earth elements. III. Gadolinium. SUGDEN, S. AND TAILBY, S. R. *J. Chem. Soc.* (*No.* 1) 137–8 (*Jan.*, 1949).—Gd has been purified by fractional crystallization of the double Mg nitrate in the presence of BiMg nitrate and the process has been followed by magnetic susceptibility measurements. The value found for $10^6\chi^{20°}_{Gd}$... is $168{\cdot}4 \pm 0{\cdot}2$. A.

538.214

2001. The magnetic susceptibilities of the rare-earth elements. IV. Thulium. SUGDEN, S. AND TAILBY, S. R. *J. Chem. Soc.*, 139–40 (*Jan.*, 1949).—Tl has been isolated by prolonged fractional crystallization of the bromate followed by treatment with Ni amalgam to remove Yb. The value found for $10^6\chi^{20°}_{Tm}$... is $136{\cdot}5 \pm 0{\cdot}1$. A.

538.22

2002. Additional ferromagnetic resonance absorption measurements on supermalloy. YAGER, W. A. Letter in *Phys. Rev.*, **75**, 316–17 (*Jan.* 15, 1949).—Results obtained for the apparent permeability (μ_R) at 24 050 Mc/s with field strengths up to about 7 000 oersted are compared with the theoretical curves and close agreement is found. The measurements established the existence of a minimum as well as a maximum in the μ_R/H curve. In fields below 2 000 oersted, $\mu_R < 1$ and the material is effectively diamagnetic with respect to the r.f. magnetic field. Results are also quoted showing the effect of cold-work. G. F. H.

538.22

2003. Ferromagnetic resonance absorption in Heusler alloy. YAGER, W. A. AND MERRITT, F. R. Letter in *Phys. Rev.*, **75**, 318 (*Jan.* 15, 1949).—Results obtained for the apparent permeability at various field strengths at 23 880 Mc/s are compared with the theoretical curve. The *g*-factor is found to be 2·01 and thus has essentially the free spin value as found also from gyromagnetic experiments. G. F. H.

538.22 : 541.128

2004. Parallelism of the development of catalytic, magnetic, and depolarising properties of specimens of manganese dioxide. AMIEL, J., RODIER, G. AND BRENET, J. *C.R. Acad. Sci., Paris*, **227**, 1356–8 (*Dec.* 20, 1948) *In French.*—9 specimens of MnO_2 have been examined for depolarizing, catalytic and magnetic properties. 2 distinct and different groups (one active) are recognized and all of the specimens, except one, fall into these groups. The unique specimen displays intermediate properties. It is concluded that for any two specimens of MnO_2 of comparable purity (one normal and the other the activated form of the normal one), the activated specimen has higher depolarizing power, enhanced catalytic activity and increased magnetic susceptibility. W. R. A.

538.22 : 621.318.2/.3 : 669.018

2005. The structure and properties of the alloy Cu_2MnIn. COLES, B. R., HUME-ROTHERY, W. AND MYERS, H. P. *Proc. Roy. Soc. A*, **196** (*No.* 1044) 125–33 (1949).—An alloy of composition $Cu_{2{\cdot}057}Mn_{0{\cdot}975}In_{0{\cdot}965}$ was prepared and was ferromagnetic in the as-cast state, and also after a variety of heat treatments. The intensities of magnetization were measured in field strengths between 7 250 and 17 150 oersteds at temperatures between −183°C and the Curie point. X-ray powder photographs show that the In alloy has the same structure as the Al Heusler alloy but with a larger lattice spacing. A.

538.221

2006. The cause of anisotropy in permanent magnet alloys. HOSELITZ, K. AND MCCAIG, M. *Proc. Phys. Soc., Lond. B*, **62**, 163–9 (*March*, 1949).—Measurements of magnetostriction have been made on samples of an anisotropic permanent magnet alloy. From the results it is concluded that the domain magnetization is, in the absence of a field, along that easy crystallographic direction which makes the smallest angle

with the axis of anisotropy. This view is supported by measurements of the remanence. The ideal arrangement which obtains after hardening seems to be slightly disturbed during the subsequent tempering operation. A.

538.221 : 538.114

2007. On the transformability of magnetization curves and the dependence on temperature of the "ideal" magnetization. GERLACH, W. AND TEMESVÁRY, A. *Z. Phys.*, **124** (*Nos* 7–12) 570–9 (1948) *In German.*—Records observations, chiefly on Ni wires, showing that magnetization curves on a given specimen at different temps. transform into one another if the H values are reduced in the ratio of the coercive forces. Such transformations hold for normal magnetization curves, hysteresis loops and "ideal" magnetization curves in the range of magnetization in which 180° reversals predominate; they do not apply as saturation is approached, where other processes are involved. The increase in magnetization produced by an alternating "idealizing" field is shown to depend only on the magnetization resulting from the d.c. field, irrespective of the combination of field-strength and temp. producing it. Results are quoted suggesting that a similar transformation applies to curves for different specimens, provided they differ only in the magnitudes of the relevant characteristic constants. The bearing of these results on Becker's theory of ferromagnetism is briefly referred to. C. E. W.

538.221 : 538.114

2008. A note on magnetic viscosity in alnico. STREET, R. AND WOOLLEY, J. C. Letter in *Proc. Phys. Soc., Lond. B*, **62**, 141–2 (*Feb.*, 1949).—Assuming the movement of domain magnetization vectors is restricted by energy barriers, the change of magnetization, ΔI, at a time t after a sudden change of applied field is given by $\Delta I = C_1 T \log (C_2 t)$. Experimental results on alnico agree with this relation, which also fits Ewing's observations on soft iron. C. E. W.

538.221 : 621.318.22

2009. Influence of relaxation and recrystallization processes on the magnetic properties of soft magnetic materials. DROZHZHINA, V. I., LUZHINSKAYA, M. G. AND SHUR, Y. S. *J. Tech. Phys., USSR*, **18**, 167–74 (*Feb.*, 1948) *In Russian.*—The investigation was more particularly concerned with the influence of the usual technological and production processes on the magnetic properties of the main materials used for building up magnetic circuits, i.e. transformer sheets (96% Fe, 4% Si) and molybdenum-Permalloy (78·5% Ni, 4% Mo, 17·5% Fe), tempered at high temperature. After various amounts of residual deformations had been set up in the specimens, they were subjected to further tempering at lower temperatures. The last procedure was found to prevent alterations of the magnetic characteristics, changes in the chemical structure having been excluded by carrying through the tempering processes in a high vacuum. The investigation revealed the unsuitability of the conventional production processes of magnetic materials which were found to be extremely sensitive to distortions of the crystal lattice, especially those of Fe–Si character. B. F. K.

538.221 : 621.318.22

2010. Magnetic properties of chrome-molybdenum steels after different kinds of heat-treatment. ZHUKOVA, P. N. AND MIKHEEV, M. N. *J. Tech. Phys., USSR*, **18**, 187–96 (*Feb.*, 1948) *In Russian.*—The possibility of controlling magnetically the heat-treatment of two sorts of chrome-molybdenum steel. Different magnetic properties were established co-existing with equal mechanical properties on hardened specimens of the steel 18 KhNMA after tempering at high temperature, depending on the method of cooling of the specimens. Careful control was needed, differing for air- and oil-tempering. A suitable instrument in the form of a remote-reading portable coercitometer was developed, which is described in detail. B. F. K.

538.222 : 539.153 : 538.569.4

2011. Paramagnetic resonance absorption in aqueous solutions of manganese sulphate. HALLIDAY, D. AND WHEATLEY, J. Letter in *Phys. Rev.*, **74**, 1724 (*Dec.* 1, 1948).—The specimen is placed axially in a cavity oscillator operating at 9 375 Mc/s. Resonance absorption occurs and as concentration increases, the resonance becomes less sharp and the value of magnetic field at which absorption occurs decreases. N. F. A.

538.224 : 536.48

2012. Magnetic behaviour of zinc and cadmium at low temperatures. MACKINNON, L. *Proc. Phys. Soc., Lond. B*, **62**, 170–9 (*March*, 1949).—Following the recent discovery of the de Haas–van Alphen effect in Zn by Marcus at liquid H temperatures [Abstr. 1909 (1947)], the effect has been investigated at liquid He temperatures using (for the most part) a torsion method similar to that used by Shoenberg in investigating Bi. The effect in Zn takes the form of a variation of the susceptibility along the hexagonal axis which is periodic in the applied magnetic field. An attempt has been made to correlate the results with Landau's explicit formulae and to derive the various relevant parameters (such as effective masses and degeneracy temperature) for the electrons causing the effect. Only qualitative agreement has been found, so that too much reliance should not be placed on the physical significance of the figures derived; however, it would appear that, as in the case of Bi, the effect is caused by only a few times 10^{-6} electrons per atom. In spite of its very similar structure, Cd did not show the effect; it had, however, at liquid He temperatures, a magnetic anisotropy some 6 times that at room temperature. A.

538.24

2013. Magnetisation of iron wires in tension. BARATTA, F. AND MILONE, A. *Nuovo Cim.*, **5**, 58–67 (*April*, 1948) *In Italian.*—A stretched Fe wire in a d.c. field shows an increase in induction in the elastic region, decrease in the plastic region and a final increase just before rupture. Broken pieces show increased residual magnetization. An explanation in terms of Villari effect and anisotropy is indicated. N. F. A.

538.24

2014. Influence of order on the saturation magnetic moment. GOLDMAN, J. E. AND SMOLUCHOWSKI, R. Letter in *Phys. Rev.*, **75**, 310–11 (*Jan.* 15, 1949).—

Measurements of the saturation moment of pure, cold-worked, quenched and annealed Fe–Co alloys at the 50 : 50 atomic composition have been made to a high degree of accuracy and at fields up to 12 500 oersted to ensure saturation. The theoretical prediction that the saturation moment of the ordered alloy should be about 4% higher than in the random alloy has been confirmed. G. F. H.

538.245/.27 : 621.3.018.3 : 621.318.22

2015. The influence of the even harmonics on the characteristics of ferromagnetic materials during simultaneous magnetization by constant and alternating magnetic fields. ROSENBLATT, M. A. *J. Tech. Phys., USSR*, **18**, 765–74 (*June*, 1948) *In Russian.*—The even harmonics of the magnetic flux density set up in the core under the simultaneous action of constant and alternating magnetic fields lower, as a rule, the mean permeability of the material of the core. In this respect the alternating field's even harmonics enhance the demagnetizing effect of the constant field. Facilitating the passage of the even harmonics of the current through the windings of magnetic amplifiers improves their characteristics and raises the amplification factor. At the same time the losses due to the even harmonics of the magnetic induction and current are reduced. In magnetic amplifiers with positive feedback the amplification factor may be considerably increased by shunting the output stage by a capacitance. A.

538.245

2016. Influence of the Austenite on the magnetization curve of steel. PARFENOV, V. V. AND JANUS, R. I. *J. Tech. Phys., USSR*, **18**, 161–6 (*Feb.*, 1948) *In Russian.*—Experimental magnetization curves obtained by commutation are given for heat-treated specimens of KhG steel, containing up to 74% Austenite, taken in fields of a strength of 20–12 000 oersted. It is found that the proportionality between magnetization and concentration of the ferromagnetic phase, natural for high fields, is substantially preserved in the range of moderate fields, in contradiction to the results of calculations previously published by Sadikov. B. F. K.

538.245

2017. On a method for studying magnetic texture. ABADIE, P. AND EPELBOIM, I. *C.R. Acad. Sci., Paris*, **226**, 1706–8 (*May* 24, 1948) *In French.*—Magnetic spectra observations on finely powered ferromagnetic materials dispersed in rubber have shown the existence of a microscopic texture. Similar observations on tape specimens show a macroscopic magnetic texture which is confirmed by further observations after electrolytic removal of the surface layers. A. E. DE B.

538.245

2018. Collective electron ferromagnetism. III. Nickel and nickel-copper alloys. WOHLFARTH, E. P. *Proc. Roy. Soc. A*, **195** (*No.* 1043) 434–62 (1948).—The collective electron treatment of ferromagnetism [Abstr. 2167 (1938), 1386 (1939)] is applied to Ni and Ni–Cu alloys. Basic formulae are given for the distribution of a constant number of electrons between overlapping bands. Numerical solutions for Ni–Cu alloys are obtained giving the numbers of occupied states in the s-band and unoccupied states in the d-band at 0°K as a function of concentration. Interchange interaction and relative magnetization are calculated for these alloys by means of Stoner's formulae. With the help of a new formula derived by the author the electron distribution at elevated temps. is computed for certain typical parameter values. The results are applied to the temp. variation of paramagnetic susceptibilities above the Curie point and a careful discussion of experimental results by Sucksmith and Pearce (1938), Wheeler (1939) and Fallot (1944) follows. The agreement with theory is good, except for the low temp. variations of Cu-rich alloys. Stoner's formulae for the electronic heat of ferromagnetics at high and low temp. is extended to overlapping bands. Comparison with experiments again shows discrepancies in the Cu-rich region. Magnetic properties of other Ni alloys are briefly considered. H. MO.

ELECTROMAGNETISM
ELECTRODYNAMICS 538.3/.5

538.3 : 53.081.5

2019. On a notation for electrodynamics adaptable to any units. FLEISCHMANN, R. *Z. Naturforsch.*, **3a**, 492–6 (*Aug.–Nov.*, 1948) *In German.*—Maxwell's equations and the equations of 4-dimensional electrodynamics are written in a notation which is independent of the system of units and can be adapted for any of the current systems. H. MO.

538.3 : 621.3.011

2020. Theory of models of electromagnetic systems. SINCLAIR, G. *Proc. Inst. Radio Engrs, N.Y.*, **36**, 1364–70 (*Nov.*, 1948).—Most model measurements are made on models which simulate only the geometrical configurations of the lines of force in the fields of the full-scale system, and thus yield only relative results for many of the properties of the system. It is possible, however, to devise models in which the measurements are on a quantitative or absolute basis in terms of the full-scale system. The conditions to be satisfied in an absolute model for accurate simulation are derived. The limitations imposed on practical models are discussed. A.

538.32

2021. On the force exerted by a rectilinear current on a parallel current. BRYLIŃSKI, E. *C.R. Acad. Sci., Paris*, **223**, 453–5 (*Sept.* 16, 1946) *In French.*—An exact expression is found for the force, involving an exact formula for the induction of a wire, in the presence of another wire. The formulae given enable an absolute definition of the ampere to be made. L. S. G.

538.522.22

2022. On the mutual inductance of two parallel coaxial circles of circular cross-section. BOUWKAMP, C. J. *Proc. K. Ned. Akad. Wet.*, **51** (*No.* 10) 1280–90 (1948) *In English.*—The mutual inductance between two parallel coaxial toroids both of circular cross-section is derived on the assumption that the current density in either ring over the corresponding section is constant. The general method is an extension of

that due to Havelock [*Phil. Mag.* (6) **15**, 332–45 (1908)] in which the coefficients are expressed in terms of integrals involving Bessel functions. Series are obtained from these integrals, their general terms found and their convergence tested. Approximate expressions for mutual inductance are developed which include terms of the fourth order in the radii of the cross-sections. Also treated are the special cases of equal-radii and coplanar toroids. S. C. D.

538.54 : 621.365.5

2023. Induction heating of a hollow specimen by a current-carrying rod. RODIGIN, N. M. *J. Tech. Phys., USSR*, **18**, 225–38 (*Feb.*, 1948) *In Russian.*—The problem of the magnetic field strength and current densities in a hollow cylinder, along the axis of which the current-carrying rod is situated, is solved. The effective and reactive powers are calculated. Further, single-layer and multi-layer cylinders are treated. The conditions for maximum intensity of Foucault currents to be obtained in a single-layer cylinder are also given. B. F. K.

538.54 : 621.365.5

2024. Heating by h.f. induction; application to the theory of melting furnaces. RENOUARD, M. *Rev. Gén. Élect.*, **57**, 322–37 (*Aug.*, 1948) *In French.*—Equations for the absorption of energy by a conductor placed in a magnetic field are derived from the vectorial electromagnetic equations, in terms of two form factors. The dependence of these form factors on the shape and dimensions of the conductor and on the penetration are shown graphically for a sheet and a cylinder. Although metals of high resistivity are less absorbing than good conductors the coefficient of transmission of incident energy is much greater. This means that, provided the thickness is great enough for complete absorption, the poorer conductors will generate more heat. The results are applied to industrial fusion furnaces which, as they have no magnetic circuit, are treated as transformers. Equivalent resistances and reactances, p.f. and efficiency are deduced, the last mentioned being electrical and thermal. The efficiency is high when the charge is cold and falls as the temperature approaches fusion point; large furnaces are more efficient than small ones. E. H. D.

538.56

2025. On Huyghens' principle for electromagnetic waves. RANDERS, G. *Forsvarets Forsknlnst. Arb.*, 6–12 (1947) *In English.*—It is shown that an electromagnetic wave disturbance at any point may be considered as resulting from a distribution of electric and magnetic dipoles over a surface through the field, at some earlier time. If the surface is a wave front of an electromagnetic wave in empty space, this theorem becomes a complete analogue of Huyghens' principle. J. A. W.

538.566 : 621.392

2026. Wave guides for slow waves. BRILLOUIN, L. *J. Appl. Phys.*, **19**, 1023–41 (*Nov.*, 1948).—A discussion of the properties of electromagnetic waves propagating with a velocity $W < c$. Boundary conditions are obtained for structures with very narrow slots, either closed or open, and a general method of solution of the wave equations is discussed. Fields in the free region and in the slot region are expanded in convenient Fourier series and these series joined along the border of both regions. In doing this, it can be proved that the field contains a dominant term, completed by corrections that represent the field distortion near the open end of the slots. Under favourable conditions, and for very narrow slots, the dominant terms are by far the most important. This allows for a simplified discussion of a variety of examples. The results agree with those of Chu and Hansen [Abstr. 984 B (1948)]. A.

538.566 : 621.392 : 621.396.67

2027. Theory of an annular resonating slot in a waveguide. LEVIN, M. L. *J. Tech. Phys., USSR*, **18**, 639–52 (*May*, 1948) *In Russian.*—The theory is given of a resonating slot aerial having the form of a narrow λ-ring cut into the "bottom" of a semi-infinite waveguide of circular cross-section. Assuming the waveguide to be provided with a flange at its end which increases the directional property of the slot radiation, the "external" conductivity of the radiation is computed. The "internal" conductivities of the radiation are then found, these being characteristics of the wave excitation inside the tube. Expressions are obtained for the reflection and transmission coefficients of H and E waves in the waveguide. The problem of the operation of a slot aerial as a receiving aerial is also solved. The effective cross-sections of excitation of the plane H and E wave of the tube are given. The question of matching two waveguides of different cross-sections by means of the annular slot is then considered. The characteristic (total) conductivity of the annular slot is investigated and it is shown that the λ-ring slot may be tuned to resonance with the exciting wave. B. F. K.

538.566 : 621.392 : 621.396.67

2028. Excitation of a semi-infinite waveguide through an aperture in its bottom. LEVIN, M. L. *J. Tech. Phys., USSR*, **18** (*No.* 5) 653–6 (*May*, 1948) *In Russian.*—A semi-infinite waveguide of arbitrary cross-section with metallic bottom is considered, the latter having an aperture of any shape cut into it. Walls and bottom of the waveguide are assumed to be ideally conducting and the space within the waveguide as vacuum without charges or currents. The excitation is provided by a layer of magnetic dipoles distributed in the plane $z = 0$ which coincides with the bottom of the waveguide. The problem is solved formally by Maxwell's equations and by a system of differential equations of the hyperbolic type (the boundary problem being formally equivalent to that of membrane oscillations). The latter are solved by Kronecker's method. The solution obtained consists of two terms, the first of which represents the superposition of the $E(TM)$ waves, and the second, of the $H(TE)$ waves of the tube. B. F. K.

538.566 : 621.396.11 : 535.42

Theory of diffraction by a circular disk and a circular hole. *See Abstr.* 1844

538.566.3 : 551.510.535 : 621.396.1

2029. Critical frequency near $\tau = 1$. ECKERSLEY, T. L. *Terr. Magn. Atmos. Elect.*, **53**, 155–61 (*June*, 1948).—A wave theory is developed which will account for observations at vertical incidence of an extraordinary ray with critical frequency at a value

corresponding to the vertical component of the gyro-frequency. It is suggested that an explanation of this critical frequency does not necessitate the existence or otherwise of the Lorentz polarization correction. [See Abstr. 867, 2260 (1939)]. W. J. G. B.

538.566.3 : 621.396.11

2030. Generalized magneto-ionic theory. GERSON, N. C. AND SEATON, S. L. *J. Franklin Inst.*, **246**, 483–94 (*Dec.*, 1948).—A vector equation relating the polarization of a homogeneous isotropic medium to an external impressed magnetic field is derived under the condition that the medium is penetrated by an electromagnetic wave. From the 3 implicit scalar relationships, a final equation involving the 4th degree of the refractive index is obtained. The identity of the quartic equation with the corresponding relationships of Appleton and Booker under the appropriate restrictive conditions is shown. A.

538.566.3 : 621.396.11

2031. Photographic record and diagrams of Luxembourg effect with resonance (gyro-interaction). CUTOLO, M. AND FERRERO, R. Letter in *Nature, Lond.*, **163**, 58–9 (*Jan.* 8, 1949).—Note on results of ionospheric wave-interaction measurements in which the frequency of the disturbing wave was equal to the local gyro-frequency. Low power transmitters (1 to 8 kW) were employed. The depth of the parasitic modulation varied from 0·25 to 3% and changed with modulation frequency in accordance with Bailey's theory. These experiments also confirm earlier suggestions of changes in the gyro-frequency with time. W. J. G. B.

538.566.5 : 535.214

2032. Radiation pressure of centimetre waves. CARRARA, N. AND LOMBARDINI, P. Letter in *Nature, Lond.*, **163**, 171 (*Jan.* 29, 1949).—The radiation pressure on an Al blade was measured at the mouth of a waveguide by means of a torsion balance. It is hoped that this experiment may provide a method for the determination of the power propagated along the guide. L. P.

MAGNETIC EFFECTS 538.6

538.61

2033. Helical paths in longitudinal and transversal photophoresis, and about Brownian movements. The unipolar magnetic charge. EHRENHAFT, F. *Acta Phys. Austriaca*, **2** (*No.* 2) 187–97 (1948) *In English.*—Describes experiments on the helical motion of particles of order of 10^{-5} cm in sunlight and under action of magnetic field. Photographs showing the tracks are given. Explanation of the phenomena is thought to rest on the unipolar magnetic charge hypothesis, since classical electrodynamics would require larger electrostatic charges than have otherwise been observed on particles of this size. N. F. A.

538.63 : 541.135

Anodic behaviour of aluminium in a magnetic field. *See Abstr.* 2180

538.632

2034. On the influence of progressive ordering and composition on the Hall effect of ordered alloys. SMIRNOV, A. A. *J. Tech. Phys., USSR*, **19**, 153–60 (*Feb.*, 1948) *In Russian.*—Hall's constant is determined for ordered alloys and it is shown that a change of sign of the Hall constant may occur during the ordering process. B. F. K.

538.639 : 537.312.8

2035. On the peculiarities of the variation of the electric resistance in a magnetic field for some ferromagnetic alloys. VONSOVSKI, S. V. *J. Tech. Phys., USSR*, **18**, 145–8 (*Feb.*, 1948) *In Russian.*—A possible explanation is offered for some recently discovered peculiarities in the relation between the signs of the longitudinal and transverse Thomson effects of a number of ferromagnetic substances. B. F. K.

538.639 : 537.312.8

2036. On the variation of the electric resistance in a magnetic field (Thomson effect) in highly coercive alloys. DROZHZHINA, V. I. AND SHUR, Y. S. *J. Tech. Phys., USSR*, **18**, 149–52 (*Feb.*, 1948) *In Russian.*—Numerous experimental investigations about the relations of longitudinal and transverse Thomson effect in ferromagnetics mostly confirmed Akulov's theory. The theory is based on the condition that there are no "volume" effects, so that, e.g., a longitudinal increase of the resistance must be compensated by a decrease of the transverse resistance. Recently it was shown that anomalies exist in highly coercive alloys, where both effects are negative. The paper presents results of the investigation of Alni-steel and Vicalloy. B. F. K.

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11 : 548.7

Surface energies of ionic crystals and metals. *See Abstr.* 2201–2

MOLECULAR STRUCTURE 539.13

539.13 : 535.333

The emission spectrum of NaH. *See Abstr.* 1802

539.132

2037. Configurations typical for structure superposition. BOCHVAR, D. A. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 5) 813–15 (1948) *In Russian.*—Some results were first obtained in concrete quantum-chemical calculations and based on definite specialized methods of approximation in quantum chemistry, among others the construction of approximate wave functions. These results are found to be special cases of general theorems which are strictly demonstrated in the general theory of superposition of states without the aid of the approximate solutions. E.g., the Heitler–London calculation of the H_2 molecule leads to the conclusion that in the case of a bond in the plane of symmetry between the nuclei (and in its close neighbourhood) the density of the

electron cloud is comparatively higher than the density of the electron cloud in that plane (or near it) that could be computed by means of any one of two wave functions at resonance taking part, taken singly. This is actually one of the partial consequences of the general theorem that may easily be derived from the characteristics of the superposition of states even before adopting an arbitrary special form of approximate wave function and/or introducing any other simplifying assumptions. The theorem is then derived and formulated. B. F. K.

539.132 : 535.338.4

Swan system of the C_2 molecule. *See Abstr.* 1814

539.132 : 541.5

2038. The properties of certain strained hydrocarbons. COULSON, C. A. AND MOFFITT, W. E. *Phil. Mag.*, **40**, 1–35 (*Jan.*, 1949).—A detailed quantum-mechanical treatment of the lower cycloparaffins, cyclobutadiene and ethylene. It is found that strained bonds are to be described as bent. Strain energies comparable with those derived from thermochemical data are calculated; the properties of strained systems are discussed; and a detailed description of the bonds in cyclopropane is given. The stability of cyclobutadiene is considered with respect to that of the related molecules benzene, cyclo-octatetraene and diphenylene, and hybridization in ethylene has been re-examined. The pairing approx. is used throughout, but the molecular-orbital method is applied qualitatively to cyclopropane. A.

539.133

2039. Electron density and polarity in benzene, naphthalene and anthracene. SCHENKEL, H. *Experientia*, **4** (*No.* 10) 383–4 (1948) *In German.*—For a number of acids (benzoic, naphthalene-1- and 2-, anthracene-1-, 2- and 9-carboxylic) the dipole moment falls as the dissociation constant rises; this shows that the higher the density of π-electrons on a given C atom, the greater its positivity. A tentative explanation is offered. S. J. G.

539.133

2040. Microwave determination of the molecular structure of chlorosilane. SHARBAUGH, A. H. Letter in *Phys. Rev.*, **74**, 1870 (*Dec.* 15, 1948).—The second rotational transition, $J = 1$ to $J = 2$, of SiH_3Cl^{35} and SiH_3Cl^{37} has been investigated by the Hughes–Wilson Stark modulation technique and values for interatomic distances and valency angle H–Si–H have been deduced. W. R. A.

539.133

2041. Variations in force constants. TORKINGTON, P. Letter in *Nature, Lond.*, **163**, 96 (*Jan.* 15, 1949).—Values of force constants for polyatomic molecules generally depend on the force fields used in their derivation and on the introduction of an interaction term into the potential energy expression to adjust for structural features. By applying a general normal coordinate treatment to the non-planar group of vibrations of related series of substituted ethylenes it has been possible to obtain consistent sets of small variations in the force constants for the non-planar bending motions and to correlate these variations with observed shifts in group frequencies and with electronegativities and electron-donating powers of substituent groups. From calculations on 12 compounds a linear relationship has been established between the CH_2 bending constant and the corresponding frequency. The principal effect appears to be analogous to the electromeric effect directing aromatic substitution. Examples are cited and briefly commented on. W. R. A.

539.133 : 535.333 : 539.155.2

The spectra of AsH_3, AsD_3 and PH_3. *See Abstr.* 1803

539.133 : 535.343.4–15

Quadrupole rotation-vibration spectrum of the hydrogen molecule. *See Abstr.* 1824

539.133 : 541.57

2042. The electronic structure of excited states of simple molecules. PAULING, L. *Z. Naturforsch.*, **3a**, 438–47 (*Aug.–Nov.*, 1948) *In English.*—The structure of excited states of symmetrical and compound diatomic molecules of first row elements is discussed. Guided by simple rules connecting bond type and ion radii, and certain qualitative physical considerations, tables of excited states of such molecules are compiled. In general there is good agreement between the radii thus predicted and the bond spectroscopic evidence. Attempts to treat dissociation energy on a similar basis are much less successful. Dissociation energies obtained from the Birge-Sponer equation and spectroscopic data and connected for the energy difference between dissociation product and the valence state of the component atom are also listed. A detailed comparison with experimental evidence is not given. H. MO.

539.133 : 543.545 : 535.343–14

Microwave spectroscopy. *See Abstr.* 1816

ATOMIC STRUCTURE . ISOTOPES 539.15

539.15 : 53.081.6

2043. On the experimental value of the fine structure constant. BETHE, H. A. AND LONGMIRE, C. *Phys. Rev.*, **75**, 306–7 (*Jan.* 15, 1949).—Recent accurate measurements of the ratio of the magnetic moments of electron and proton, and of the hyperfine structure separation of the ground state of the H atom, allow an accurate determination of the fine-structure constant α from the corrected Fermi hyperfine-structure formula. This paper gives a critical discussion of both this determination and of that previously made by DuMond and Cohen [Abstr. 2515 (1948)] and based on other experiments. No definite discrepancy exists between the results. The most reliable value is $\alpha = 137{\cdot}041 \pm 0{\cdot}005$. L. P.

539.152.1

2044. On the ground state of the deuteron. LOW, F. Letter in *Phys. Rev.*, **74**, 1885–6 (*Dec.* 15, 1948).—A discussion of the exact equation $\int_0^\infty V(r)u(r)\sinh \alpha r dr = -\alpha\hbar^2/M$ for the estimation of the depth-range relation of potentials $V(r)$ where $\alpha^2 = -ME/\hbar^2$. This formula is due to C. Longmire. G. J. K.

539.152.1

2045. Tensor forces and the neutron-proton interaction. PADFIELD, D. G. Letter in *Nature, Lond.*, **163**, 22 (*Jan.* 1, 1949).—Results are given on the square-well interactions necessary to give the correct binding energy, quadrupole moment and D-state in the bound state of the deuteron. Given the central force ranges ($r_0 = 1{\cdot}6$, $1{\cdot}8$, $2{\cdot}0$ and $2{\cdot}2 \cdot 10^{-13}$ cm) its magnitude V_0 and the range and amplitude of the tensor force are determined. V_0 varies considerably with r_0, but the tensor force is almost independent of it, and has a range of 3×10^{-13} cm and a depth of 10 MeV approximately. G. J. K.

539.152.1 : 523.87

2046. The continuous absorption coefficient of the helium atom. HUANG, S.-S. *Astrophys. J.*, **108**, 354–72 (*Nov.*, 1948).—The absorption of He I for transitions from the ground state 1^1S and the two metastable states 2^3S and 2^1S to the continuum is calculated by quantum-mechanical methods using the matrix elements not only of dipole moment, but also of momentum and acceleration. The first 2 methods give results in good agreement. The *f*-sum rule is approx. satisfied for the 3 states considered. L. P.

539.152.1 : 536.48

2047. On the production of nuclear polarization. ROSE, M. E. Letter in *Phys. Rev.*, **75**, 213 (*Jan.* 1, 1949).—It is shown that $\sim 20\%$ nuclear polarization can be produced in non-paramagnetic atoms with fields of 20 000–30 000 gauss, if the materials can be cooled to $\sim 0{\cdot}01$°K. With paramagnetic substances, temperatures of $0{\cdot}01$–$0{\cdot}1$°K should suffice. A. P. F.

539.152.1 : 537.531

Radiative X-ray transition within the *L*-shell of sulphur. *See Abstr.* 1933

539.152.1 : 537.534.74 : 539.185

2048. Scattering of like particles at 100 MeV. BARKER, F. C. AND RAVENHALL, D. G. Letter in *Nature, Lond.*, **163**, 20 (*Jan.* 1, 1949).—Previous calculations [Abstr. 2588 (1948)] are extended to *n–n* and *p–p* scattering at 100 MeV with symmetric or charged forces, using an exponential well of range $0{\cdot}5 \times 10^{-13}$ cm. For *n–n* scattering, exchange forces give a considerably larger total cross-section than symmetric forces. The ratio of *n–n* : *n–p* cross-sections is given and differs considerably from the Born approximation. G. J. K.

539.152.1 : 539.164

Spin-orbit coupling in Li^7. *See Abstr.* 2083

539.152.1 : 539.172.44 : 539.166.2

The mean life of the 478·5 keV excited state of Li^7. *See Abstr.* 2121

539.152.1 : 539.18

The atomic capture of slow mesons. *See Abstr.* 2127

539.152.1 : 539.18 : 537.534.74

2049. On the definition of the "effective range" of nuclear forces. BARKER, F. C. AND PEIERLS, R. E. Letter in *Phys. Rev.*, **75**, 312–13 (*Jan.* 15, 1949).—A simple expression for the effective range r_e defined by the equation for the scattering phase as a function of energy $k \cot \delta = -(1/a) + \frac{1}{2} r_e k^2$ where $k^2 = ME/\hbar^2$ is obtained in terms of the wave-function and its asymptotic form. G. J. K.

539.152.1 : 539.185

Scattering and absorption of neutrons by polarized nuclei. *See Abstr.* 2131

539.152.2

2050. Determination of the magnetic moment of Na^{23}_{11} by the nuclear induction method. BOLLE, A. AND ZANOTELLI, G. Letter in *Ric. Sci.*, **18**, 847 (*July*, 1948) *In Italian.*—Measurements on the magnetic moment of Na^{23} have been carried out using the methods of Bloch, Hansen and Packard. Good agreement is obtained with results of the molecular beam method. U. C.

539.152.2

2051. The magnetic moment of aluminium^{27}. ZIMMERMAN, J. R. AND WILLIAMS, D. Letter in *Phys. Rev.*, **75**, 198–9 (*Jan.* 1, 1949).—Nuclear magnetic resonance in aqueous solutions of Al^{27} salts leads to a line 1 gauss wide near 5 900 gauss at $6{\cdot}5$ Mc/s in good agreement with the magnetic moment found by Millman and Kusch [Abstr. 4040 (1939)] using a molecular beam technique. D. H. W.

539.152.2

2052. Magnetic moments of deuterium-2, lithium-7 and fluorine-19. SIEGBAHN, K. AND LINDSTRÖM, G. Letter in *Nature, Lond.*, **163**, 211 (*Feb.* 5, 1949).—By observing simultaneously the magnetic resonance of a proton and the comparison nucleus placed in two equivalent portions of a magnetic gap, an accurate value of the magnetic moment ratios is obtained from the respective resonance frequencies. Values of the moment found are D^2 $0{\cdot}3070183 \pm 0{\cdot}0000015$, Li^7 $1{\cdot}165833 \pm 0{\cdot}000050$, F^{19} $0{\cdot}940934 \pm 0{\cdot}000015$ times the proton moment. D. H. W.

539.155.2

2053. Isotopic weights of medium elements. OGATA, K. Letter in *Phys. Rev.*, **75**, 200–1 (*Jan.* 1, 1949).—Isotopic weights of all isotopes of Cr, Fe, Zn, Br were determined in a mass spectrograph, by measurement of doublets produced with organic vapour mixtures in the discharge-tube ion source and by subsequent calculation from the known values of H^1, C^{12}. The isotopic weights, packing fractions and binding energies are tabulated; packing fractions of different isotopes of the same element differ considerably. The minimum of the packing fraction curve occurs near Cr or Fe. T. G. P.

539.155.2 : 53.081.7

2054. Table of isotopes. SEABORG, G. T. AND PERLMAN, I. *Rev. Mod. Phys.*, **20**, 585–667 (*Oct.*, 1948).—Complete list of all isotopes, natural and artificial, stable and radioactive. Gives following data: percentage abundances, type and energy of radiation, ½-life, and source (natural or from nuclear reactions). 29 pp. of references.

539.155.2 : 533.15

2055. Concentration of He^3 by thermal diffusion. MCINTEER, B. P., ALDRICH, L. T. AND NIER, A. O. *Phys. Rev.*, **74**, 946–9 (*Oct.* 15, 1948).—A thermal diffusion plant for the enrichment of He^3 has been constructed consisting of cylindrical columns followed by a hot wire column. In the case of the cylindrical columns excellent agreement with the theory of Jones and Furry has been obtained. In the case of the hot wire column, discrepancies exist between the observed

performance and that predicted by theory. Under continuous operating conditions it was possible to produce with the expenditure of 16·6 kW, 14 std. cc of He per day having a He^3/He^4 ratio of 0·0021 when well He was used as a source of gas. A.

539.155.2 : 536.71 : 536.48

The condenser phase of the light helium isotope. *See Abstr.* 1877

539.155.2 : 537.534

Intense ion beams in a mass spectrometer. *See Abstr.* 1945

539.155.2 : 541.133.1

2056. Concentration increase of heavy thallium isotope by electrolytic migration in molten thallium chloride. KLEMM, A., HINTENBERGER, H., SEELMANN-EGGEBERT, W. *Z. Naturforsch.*, **3a**, 622–4 (*Aug.–Nov.*, 1948) *In German.*—It is shown that concentration of Tl^{205} in a 203/205 mixture can be achieved by electrolysis of molten TlCl. A separation factor 1·5 was obtained by electrolysis with current density 6 A/cm² during 8 days, the difference of the migration rates being 0·4%. H. MO.

539.155.2 : 551.510.4 : 523.77 : 535.334

Carbon and oxygen isotopes in the earth's atmosphere. *See Abstr.* 2233

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16 : 550.93

2057. Argon 40 in potassium minerals. ALDRICH, L. T. AND NIER, A. O. *Phys. Rev.*, **74**, 876–7 (*Oct.* 15, 1948).—An investigation was made of the isotopic composition of the A from four K minerals. In each case a high A^{40}/A^{36} ratio, compared to that of atmospheric A, was observed, showing directly that K^{40} decays to both Ca^{40} and A^{40}. From the absolute amounts of radiogenic A^{40} and K^{40} in the minerals a lower limit on the branching ratio λ_K/λ_β can be made. If the ½-life, 7×10^8 yr, is assumed for $K^{40}\rightarrow Ca^{40}$, λ_K/λ_β must be at least 0·02. The possibility of using this method for measuring geological age is suggested. A.

539.16 : 778.3

2058. Recording of charged particles of minimum ionizing power in photographic emulsions. BERRIMAN, R. W. Letter in *Nature, Lond.*, **162**, 992–3 (*Dec.* 25, 1948).—A new type of nuclear emulsion (Kodak NT4) is described which is capable of recording tracks of charged particles at minimum ionizing power. This result was achieved by a threefold increase of the sensitivity of a previous electron recording emulsion (Kodak NT2a). Photomicrographs of tracks of electrons of several 100 μ length in the emulsion are shown and straight line tracks due to high energy particles at minimum ionizing power of lengths up to 10 000 μ have been observed. It is considered that the NT4 emulsion is capable of recording tracks of charged particles of any energy. R. H. H.

539.16.08 : 537.531 : 539.167

2059. Investigation of soft radiations by proportional counters. I. CURRAN, S. C., ANGUS, J. AND COCKCROFT, A. L. *Phil. Mag.*, **40**, 36–52 (*Jan.*, 1949).—The possibilities of detecting and measuring the energy of soft radiation, particularly β-radiation, γ-radiation and K-capture X-rays, in the range 30 eV to 150 keV are discussed and verified experimentally. It is shown that high sensitivity, good resolution and accuracy of energy determination can be obtained through most of this range by combining a suitably designed proportional counter and high gain amplifier of low noise level. The energy required per ion pair formed by electrons of energy between ~ 200 eV and 50 keV is found to be nearly constant for A and N gases. The K-capture radiation of Cu^{64} and the γ- and X-radiation emitted by RaD are analysed. A.

539.16.08 : 537.542.1

A spherical proportional counter. *See Abstr.* 1959

539.16.08 : 539.165 : 539.166

2060. Effect of absorber position on counting rate of collimated and uncollimated beta and gamma radiation. JOHNSTON, F. AND WILLARD, J. E. *Science*, **109**, 11–12 (*Jan.* 7, 1949).—Tables are given of the variation in the counting rates produced by sources of P^{32} and Co^{60} as the absorber position is changed. The largest variation was by a factor >3, for collimated β-radiation, the least a change of 20%, for collimated γ-radiation. B. R.

539.16.08 : 539.185 : 614.8

Tolerance flux of thermal neutrons. *See Abstr.* 2133

539.16.08 : 614.898

2061. Measurement of alpha-active dust in the atmosphere. CARMICHAEL, H. AND TUNNICLIFFE, P. R. *J. Indust. Hyg. Toxicol.*, **30**, 212–27 (*July*, 1948).—Apparatus of 2 kinds for rapidly extracting the dust from large volumes of atmospheric air so that the α-particle activity of the dust can readily be measured in a methane proportional counter is described. The performance of the apparatus has been studied using the natural α-activity in the atmosphere due mainly to radon and thoron and their disintegration products. Suction, provided by a commercial vacuum cleaner, is at the rate of 2·0 m³/min in the electrostatic precipitation apparatus, but only 0·8 m³/min in the filter apparatus. Extraction of dust at these rates of flow is 40% for the precipitator and 100% for the filter. Counting efficiency is 49% for the precipitator but only 14% for the filter due to penetration of the dust into the paper. The overall counting yield of the precipitator, for a given time of extraction of dust, is nearly 4 times that of the filter. It is necessary to have both types of apparatus in order that experimental determinations of the counting yield of either can be made from time to time. At least 6 hours must usually elapse after collection of a dust sample before U or Pu of about the present health toleration concentration can be measured, because the natural α-particle activity of atmospheric dust must first be allowed time to decay. A.

539.16.08 : 621.317.723

2062. Radioactivity health survey meter. CARLIN, J. R. *Radio-Electronic Engng* [Issued with *Radio Televis. News*] **11**, 16–19 (*Aug.*, 1948).—The potency of α, β and γ radiation is described and the roentgen or "r" unit and the roentgen/hr unit defined. It is

stated that the max. safe human dosage is 12·5 milliroentgen (mr)/hr for an 8-hour working day and the effects of over-exposure are described. The survey meter is a portable monitor, consisting of a short length of tenite tubing, which acts as the ionization chamber, attached to the gauge. The latter is a 3-range instrument incorporating a battery-driven sub-miniature electrometer valve and a 0–15 μA meter, giving ranges of 0–25, 0–250 and 0–2 500 mr/hr, range switching being effected by change of grid resistor. Two variable and one preset controls make the instrument self-calibrating in use and provide an automatic warning of battery decay. H. G. M. S.

539.16.08 : 621.318.572

2063. A new pulse amplitude-discriminator circuit. COOKE-YARBOROUGH, E. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 96–8 (*March*, 1949).—A circuit is described which discriminates against pulses smaller than those it is desired to count and which provides a known constant dead time, enabling counting losses to be accurately determined without complete knowledge of the resolving time of other equipment in the counting chain. These counting losses are calculated and the condition whereby the counting rate is independent of the input pulse width is deduced. A.

539.16.08 : 778.3

2064. Investigation of the distribution of the radioactive elements in rocks by the photographic method. POOLE, J. H. J. AND BREMNER, J. W. Letter in *Nature, Lond.*, **163**, 130–1 (*Jan.* 22, 1949).—The α-particle emission of radioactive elements in rocks is examined by means of nuclear plates which are placed after exposure and processing in accurate contact with microscope slides of the rock. The distribution of the α-rays can thus be topographically correlated with the rock minerals. From the number of α particles emitted a rough estimate of the U content of the rock is made. R. H. H.

539.162 : 539.165.2

2065. Energy diagrams for beta-disintegration. HUGHES, A. L. *Amer. J. Phys.*, **16**, 415–20 (*Nov.*, 1948).—Discusses, and interprets for β-disintegrations (β^-, β^+, K capture), the two representations of energy diagrams in terms of nuclear mass and atomic mass. Electronic binding energies are taken into account in Part II. A. O. S.

539.163

2066. Internal conversion electrons from metastable Te^{125}. HILL, R. D., SCHARFF-GOLDHABER, G. AND FRIEDLANDER, G. Letter in *Phys. Rev.*, **75**, 324 (*Jan.* 15, 1949).—The $\frac{1}{2}$-life was found to be 58 $\pm$ 4 days. Measurements in a 180° spectrometer showed 4 electron lines, 3 being ascribed to a 109·3 keV γ-ray. From the ratios of the internal conversion coefficients, it is suggested that the spin change between the metastable state and the ground state is 4. B. R.

539.163 : 539.166

2067. Metastable state of Sc^{46}. GOLDHABER, M. AND MUEHLHAUSE, C. O. Letter in *Phys. Rev.*, **74**, 1877–8 (*Dec.* 15, 1948).—This state, produced by slow neutrons on Sc^{45}, had a $\frac{1}{2}$-life of 20 sec and a γ-ray energy of $\sim$ 180 keV (Pb absorption). An Al absorption curve indicated internal conversion electrons of energy 165 keV. B. R.

539.163 : 539.167

2068. Mass spectrographic assignment of rubidium isotopes. REYNOLDS, F. L., KARRAKER, D. G. AND TEMPLETON, D. H. Letter in *Phys. Rev.*, **75**, 313–14 (*Jan.* 15, 1949).—The $\frac{1}{2}$-lives (5·0 and 6·3 hr respectively) and the radiations of Rb^{81} and Rb^{82}, produced by high energy α-bombardment of Br, were determined, mainly by absorption methods. The masses were determined relative to natural Rb^{85} and Rb^{87}, and the lines at masses 81 and 82 shown to be radioactive. B. R.

539.163 : 539.17

2069. Artificial collateral chains to the thorium and actinium families. GHIORSO, A., MEINKE, W. W. AND SEABORG, G. T. Letter in *Phys. Rev.*, **74**, 695–6 (*Sept.* 15, 1948).—Two new series of α-active elements, $_{91}Pa^{228}$, $_{89}Ac^{224}$, $_{87}Fr^{220}$, $_{85}At^{216}$ and $_{91}Pa^{227}$, $_{89}Ac^{223}$, $_{87}Fr^{219}$, $_{85}At^{215}$, collateral with the thorium ($4n$) and actinium ($4n + 3$) series resp., have been produced by irradiating thorium with deuterons of $\sim$ 80 MeV and separating the protactinium fraction. The α-particle energies were investigated using an α-particle pulse analyser, and the $\frac{1}{2}$-lives roughly measured. Orbital-electron-capture branching occurs at Pa^{228}, Ac^{224}, and Pa^{227} with K/α ratios of $\sim$ 50, $\sim$ 10 and $\sim$ 0·2. A. O. S.

539.163 : 539.17

2070. Three additional collateral alpha-decay chains. MEINKE, W. W., GHIORSO, A. AND SEABORG, G. T. Letter in *Phys. Rev.*, **75**, 314–15 (*Jan.* 15, 1949).—Additional branches of the $4n$, $4n + 1$ and $4n + 2$ series, produced by high energy α-bombardment of thorium, are listed, including particle energies and measured or predicted $\frac{1}{2}$-lives. The respective heads of the branches are $_{92}U^{228}$, $_{92}U^{229}$ and $_{91}Pa^{226}$. Also listed are revised values for the pre iously reported Pa^{227} and Pa^{228} collateral chains [Abstr. 2069 (1949)]. B. R.

539.163.1.08

2071. Delayed coincidence measurements for determining the half-lives of short-lived metastable nuclei (isomers). LUNDBY, A. *Forsvarets ForsknInst. Arb.*, 13–23 (1947) *In English.*—Two methods based on delayed-coincidence counting are described for measuring $\frac{1}{2}$-lives between 10^{-7} and 10^{-2} sec. The problem is that of determining the probability that a nucleus B, resulting from decay of a nucleus A on emission of a β-particle or γ-ray, at $t = 0$, shall decay to the ground state C. In the integrational method the coincidences between AB and all following γ-rays up to time t are determined, in the differential method the coincidences occurring from t to $t + \theta$ are counted. The apparatus is described and shown in diagrams, the theory is given and the limitations of the methods are discussed. J. A. W.

539.163.2

2072. The beta-decay spectra of B^{12} and Li^8. HORNYAK, W. F., DOUGHERTY, C. B. AND LAURITSEN, T. Letter in *Phys. Rev.*, **74**, 1727–8 (*Dec.* 1, 1948).—The sources were produced inside a lens spectrometer by deuteron bombardment. The B^{12} spectrum yielded a linear Kurie plot down to $5\frac{1}{2}$ MeV and an extrapolated end point at 13·43 $\pm$ 0·06 MeV. The Li^8 spectrum gave a very curved Kurie plot at both

high and low energy ends, the best straight line giving an extrapolated end point at 12·7 MeV, consistent with α-particle data from the same reaction. B. R.

539.163.2

2073. The beta-ray spectra of Cu^{64}. Wu, C. S. and Albert, R. D. Letter in *Phys. Rev.*, **75**, 315–16 (*Jan.* 15, 1949).—Using the previously described solenoid spectrometer [Abstr. 2182 (1941)], the low energy excess of both positrons and electrons was examined for source thicknesses from 0·3 to 0·1 mg/cm², and found to diminish with the source thickness. A more rigorous Coulomb and relativistic correction factor was applied, and the difference between experimental and theoretical distributions found to be 1–2% of the total emission, instead of 6–9% previously reported [Abstr. 1903 (1948)]. B. R.

539.163.2

2074. Disintegration of Hg^{203}. Slätis, H. and Siegbahn, K. Letter in *Phys. Rev.*, **75**, 318–19 (*Jan.* 15, 1949).—The β-endpoint, which is normally masked by *K*- and *L*-conversion lines, was found, by extrapolating the Fermi plot of the β-γ coincidence spectrum, to be 208 keV. The γ-ray energy was found to be 279 ± 2 keV from measurements of internal- and lead-conversion lines. B. R.

539.163.2

2075. Investigation of soft radiations. II. The beta spectrum of tritium. Curran, S. C., Angus, J. and Cockcroft, A. L. *Phil. Mag.*, **40**, 53–60 (*Jan.*, 1949).—The β-spectrum of tritium is investigated between 0·5 keV and the upper energy limit, 17·9 keV. Detailed results near the low energy end and close to the upper limit are presented. The spectrum is shown to be simple and in reasonable agreement with Fermi theory. There is evidence of some deficiency in β-rays of low energy. The best fit with theory is obtained for a neutrino mass $\mu = m/500$ (m = electron rest mass). A.

539.163.2 : 539.165

2076. Observations of naphthalene scintillations caused by tritium beta-rays. Taschek, R. F. and Gittings, H. T. Letter in *Phys. Rev.*, **74**, 1553 (*Nov.* 15, 1948).—A preliminary report is given on the scintillations produced in commercial naphthalene by β-rays from tritium. Individual pulses down to 10 keV β energy were observed: an estimate of the lower limit of conversion efficiency gave 6%. U. C.

539.163.2 : 539.165

2077. Radiation from columbium 95. Hudgens, G. E. and Lyon, W. S. Letter in *Phys. Rev.*, **75**, 206–7 (*Jan.* 1, 1949).—The energies of the β- and γ-radiations from 35 day and from 90 hour Cb were determined with a magnetic lens spectrometer. The ratios of the conversion electrons to the continuous β-particles were also determined, and the ½-life of the short-lived isomer remeasured. B. R.

539.163.2 : 539.166 : 539.167

2078. Evidence for a complex disintegration of I^{131}. Owen, G. E., Moe, D. and Cook, C. S. Letter in *Phys. Rev.*, **74**, 1879–80 (*Dec.* 15, 1948).—Using a 180° spectrometer, many internal conversion lines were found and interpreted in terms of γ-rays of energies 83 ± 2, 368 ± 7, 163 ± 3 and 286 ± 6 keV. An excited level in Xe^{131} at 450 keV, with parallel cascade transitions to the ground state, is suggested. A Kurie plot of the continuous β-spectrum, which yields an extrapolated end point of 597 ± 5 keV, is non-linear below 250 keV. B. R.

539.163.2 : 539.166

2079. On the Cs^{137} disintegration scheme. Mitchell, A. C. G. and Peacock, C. L. Letter in *Phys. Rev.*, **75**, 197 (*Jan.* 1, 1949).—The *K*- and *L*-conversion lines of the 663 keV γ-ray have been measured, and N_K/N_L found to be 4·8 ± 0·3, the internal conversion coefficient α_K being 11·8%. The ½-life of the metastable state of Ba^{137} was found to be 156 ± 3 sec, in agreement with earlier work [see Abstr. 281 (1949)]. A spin change of 5 is suggested for the γ-ray emission, on 3 lines of evidence. A level diagram is proposed and difficulties discussed. B. R.

539.163.2 : 539.172

2080. Some new radioactive isotopes of Tb, Ho, Tm, Lu, Ta, W and Re. Wilkinson, G. and Hicks, H. G. Letter in *Phys. Rev.*, **74**, 1733–4 (*Dec.* 1, 1948).—A table is given showing 22 activities, with the type and energy of the radiation, produced by bombardments in the 60 in Berkeley cyclotron. B. R.

539.163.4 : 541.124/.127

The effects of high energy radiations on water and aqueous systems. *See Abstr.* 2177

539.163.4 : 548.736.33

2081. The first isolation of element 93 in pure compounds and a determination of the half-life of $_{93}Np^{237}$. Magnusson, L. B. and LaChapelle, T. J. *J. Amer. Chem. Soc.*, **70**, 3534–8 (*Nov.*, 1948).—Neptunium has been shown to exist in Np^{+4} and Np^{+6} states by preparation and X-ray identification of neptunium dioxide, NpO_2, and Na neptunium dioxytriacetate, $NaNpO_2(CH_3.COO)_3$. NpO_2 crystals are cubic, face-centred, containing 4 molecules per unit cell, lattice constant 5·42 ± 0·01 Å, having 8 O atoms around each Np atom and Np–O distance = 2·35 Å. $NaNpO_2(CH_3.COO)_3$ crystals are cubic with lattice constant = 10·659 ± 0·002 Å. The ½-life of $_{93}Np^{237}$ is computed to be $2{\cdot}20\times10^6$ years. W. R. A.

539.164

2082. Alpha-decay systematics of the heavy elements. Perlman, I., Ghiorso, A. and Seaborg, G. T. Letter in *Phys. Rev.*, **74**, 1730–2 (*Dec.* 1, 1948).—A plot of α-particle energy against mass-number for the known α-decaying isotopes of the heavy elements from Bi to Cm, including many recently discovered, shows certain marked regularities. For each element, starting with the heaviest isotope, as the mass-number decreases the α-energy shows a nearly parallel increase, in the case of the elements of lowest atomic number (Bi, Po, At) to a maximum followed by a minimum. [See also Abstr. 2177 (1948)]. A. O. S.

539.164 : 539.152.1

2083. The nuclear spin of B^{10} and spin-orbit coupling in Li^7. Inglis, D. R. Letter in *Phys. Rev.*, **74**, 1876–7 (*Dec.* 15, 1948).—A discussion of the $B^{10}(n, \alpha)$ Li^7 reaction leads to the suggestions that the greater intensity of the short-range α-particles is associated with the large nuclear spin of B^{10}, and that the excited

state of Li^7 is a ^2F state, 450 keV above the ground state. G. J. K.

539.164 : 539.172.11

Formation of U^{232} from thorium. *See Abstr.* 2114

539.164.08

2084. Measurements of α-particle energies with the crystal fluorescence counter. Broser, I. and Kallmann, H. Letter in *Nature, Lond.*, **163**, 20–1 (*Jan.* 1, 1949).—The light output measured with a photomultiplier, of a large single crystal of Cd sulphide (surface density ~ 10 mg/cm^2, area several cm^2) prepared by the method of Frerichs [Abstr. 3538 (1947)], bombarded with α-particles, is directly proportional to the energy of the incident particles up to the max. energy (~ 5 MeV) of the Po α-particles used; an intensity of 100 α-particles/sec could be measured. With nearly mono-energetic incident α-particles the differential pulse amplitude spectrum shows a corresponding sharp maximum. The spectrum of the emitted light has a max. $\sim 8\,000$ Å ($\sim 1{\cdot}7$ eV). The best crystals require $\sim 7{\cdot}7$ eV/light quantum emitted. A. O. S.

539.165 : 539.155.2 : 537.533.7

2085. The beta-ray spectra of europium and tungsten. Shull, F. B. *Phys. Rev.*, **74**, 917–25 (*Oct.* 15, 1948).—Reports the results of a spectrometric investigation of β- and γ-radiations from certain isotopes of Eu and W. Information concerning the design and operation of the magnetic double-focusing β-ray spectrometer with which the investigation was carried out is also published. The spectra for Eu and W illustrate the performance. A.

539.165 : 539.162

2086. Screening and relativistic effects on beta-spectra. Longmire, C. and Brown, H. *Phys. Rev.*, **75**, 264–9 (*Jan.* 15, 1949) erratum 1102 (*April* 1, 1949).—The effect of screening by atomic electrons on the form of allowed β-ray spectra of the Fermi theory is calculated approximately, with the assumption of a screened potential based on the Thomas–Fermi model of the atom. The apparent deviation from theory caused by neglecting screening is given for the β-emitters S^{35}, Cu^{64}, and RaE. Another smaller source of error in interpreting experimental results is the use of the non-relativistic approximation to the Coulomb correction factor. These effects cannot be neglected in an accurate analysis of data for Cu and heavier elements. A.

539.165 : 539.172.1

The reaction $B^{11}(pd)$. *See Abstr.* 2112

539.165.08 : 537.533.72

The focusing of β-rays in a prolate spheroidal magnetic field. *See Abstr.* 1937

539.166 : 539.163

Metastable state of Sc^{46}. *See Abstr.* 2067

539.166 : 539.17

2087. Radiations from Te^{121}. Hill, R. D. and Mihelich, J. W. Letter in *Phys. Rev.*, **74**, 1874 (*Dec.* 15, 1948).—An investigation, with a β-ray spectrometer, of the electrons involved in the highly converted γ-ray transition of 143 days ½-life in Te^{121} has produced 18 lines. These show with certainty 4 transitions at 82, 88·5, 159 and 213 keV. The relative intensities have been obtained and the decays followed. All the intensities decay with the 143-day ½-life. No obvious scheme, in which the observed transitions can be combined, is apparent. G. O. B.

539.166.74

2088. Large-angle scattering of Na^{24} gamma-radiation. Pollard, E. and Alburger, D. E. *Phys. Rev.*, **74**, 926–32 (*Oct.* 15, 1948).—Scattering of the 1·38 MeV and 2·76 MeV γ-radiation of Na^{24} has been observed at a mean angle of 135°. Mg, Al, Pb, and Hg scatterers were used, and three definite components of scattered radiation were observed. The softest, of energy ~ 200 keV, is Compton-scattered radiation; the next hardest, of energy 500 keV, is the positron annihilation radiation. The third has an energy between 1·1 and 2·8 MeV. It is due, in part, to bremsstrahlung, but seems to be somewhat too hard to be wholly explained by this process. It is not sharply resonant nuclear scattering since it appears nearly equally in Mg and Al, while only Mg should be sharply resonant. From the lack of sharp resonance with the Mg^{24} level at either 1·38 MeV or 2·76 MeV, it is concluded that these levels must be less than 1/100 eV wide and that the corresponding transitions are of quadrupole or higher order. A.

539.166.74 : 537.531 : 535.3

2089. Note on polarization effects in Compton scattering. Wightman, A. *Phys. Rev.*, **74**, 1813–17 (*Dec.* 15, 1948).—A derivation of the probability of Compton scattering for an arbitrary initial and final photon polarization is sketched. The result is applied to the case of 2 successive Compton scatterings, and some possibilities of experimental verification are discussed. A remark is made on a simplification of the calculations of Compton scattering when it is used to analyse the polarization of annihilation quanta. A.

539.166.79

2090. Internal conversion of the radiation of a magnetic multipole. Berestetski, V. B. *J. Exp. Theor. Phys., USSR*, **18** (*No.* 12) 1057–69 (1948) *In Russian.*—The calculation is given of the coefficients of the internal conversion of a magnetic multipole in the K and L rings in a non-relativistic approximation taking account of the electron bonds. A.

539.166.79

2091. Angular correlation in the internal conversion of γ-rays. Berestetski, V. B. *J. Exp. Theor. Phys., USSR*, **18** (*No.* 12) 1070–80 (1948) *In Russian.*—The correlation is considered between the directions of a γ-quantum and the conversion electron, or between 2 conversion electrons in two successive transitions. A.

539.166.79

2092. Doppler broadening of a gamma-ray line. Rasmussen, V. K., Lauritsen, C. C. and Lauritsen, T. Letter in *Phys. Rev.*, **75**, 199–200 (*Jan.* 1, 1949).—The 477 keV γ-radiation from Li^{7*}, produced by 3 different processes, was examined with a magnetic lens spectrometer. The line from the reaction $Be^9(d, \alpha)Li^{7*}$ was unsymmetrical in shape, and of width $4{\cdot}1 \pm 0{\cdot}1\%$. The widths obtained from the reactions $Li^7(p, p')Li^{7*}$ and $Be^7(K)Li^{7*}$ were $2{\cdot}2 \pm 0{\cdot}1\%$ and $2{\cdot}1 \pm 0{\cdot}1\%$ respectively. The peak from

the first process was displaced downwards by several keV, that from the second process upwards by $1{\cdot}6 \pm 0{\cdot}5$ keV, from the peak due to the third process. These results are explained in terms of the Doppler effect. B. R.

539.166.8

2093. Directional correlation between successive internal-conversion electrons from tantalum-181.* WARD, A. H. AND WALKER, D. Letter in *Nature, Lond.*, **163**, 168 (*Jan.* 29, 1949).—Coincidence rates between pairs of counters at 90° and 180° were found to give $(C(180°) - C(90°))/C(90°) = -0{\cdot}32 \pm 0{\cdot}08$, the angular resolution being $\pm 8°$. B. R.

539.167 : 539.16.08 : 537.531

Investigation of soft radiations by counters. *See Abstr.* 2059

539.167 : 539.163

Mass spectrographic assignment of Rb isotopes. *See Abstr.* 2068

539.167 : 539.163.2 : 539.166

Evidence for a complex disintegration of I^{131}. *See Abstr.* 2078

539.167.3

2094. Radiations from Cd^{115}, $*In^{115}$, and Hf^{181}. MANDEVILLE, C. E., SCHERB, M. V. AND KEIGHTON, W. B. *Phys. Rev.*, **75**, 221–6 (*Jan.* 15, 1949).—The characteristic radiations of Cd^{115}, $*In^{115}$, and Hf^{181} have been measured by absorption and coincidence methods. The β-γ-coincidence rate of Cd^{115} indicates the presence of an inner β-ray group at 0·46 MeV. Coincidence measurements show that the 4-hour isomer of In (115) decays with the emission of a single partially converted γ-ray. Hf^{181} was found to emit 0·52 MeV β-rays (Al absorption) and 0·17 and 0·47 MeV γ-rays (Pb absorption). β-γ-coincidence data indicate that the β-ray spectrum of Hf^{181} could be complex. β-β- and γ-γ-coincidence data were also obtained. A.

539.167.3

2095. Evidence for a new isotope of potassium. OVERSTREET, R., JACOBSON, L. AND STOUT, P. R. *Phys. Rev.*, **75**, 231–3 (*Jan.* 15, 1949).—A study of the K isotopes produced by the bombardment of A with He ions reveals the presence of a hitherto unknown isotope with a 22·4 hour $\frac{1}{2}$-life. It has two β-components of $\sim 0{\cdot}25$ MeV and 0·8 MeV max. energies. A γ-component is present of $\sim 0{\cdot}4$ MeV energy. The evidence strongly suggests that the isotope in question is K^{43} produced by the reaction $A^{40}(\alpha, p)K^{43}$. A.

539.167.3

2096. The radiations from Hf^{181}. CHU, K. Y. AND WIEDENBECK, M. L. *Phys. Rev.*, **75**, 226–31 (*Jan.* 15, 1949).—The β-spectrum and photoelectron spectrum of Hf^{181} have been studied with a semicircular focusing β-ray spectrograph of 2% resolving power. In addition to the continuous β-spectrum, 4 partially converted γ-rays were found. An estimate of the relative intensities of the 2 higher energy γ-rays can be made from the Compton and photoelectron intensities. Data have also been obtained from β-γ and β-e^- coincidence measurements. An energy level diagram is discussed. A.

539.167.3

2097. Radioactivity of C^{10} and O^{14}. SHERR, R., MUETHER, H. R. AND WHITE, M. G. *Phys. Rev.*, **75**, 282–92 (*Jan.* 15, 1949).—A new activity, O^{14}, has been produced from N^{14} by a (pn) reaction and is found to decay with a $\frac{1}{2}$-life of $76{\cdot}5 \pm 2$ sec by the emission of $1{\cdot}8 \pm 0{\cdot}1$ MeV positrons and a 2·3 MeV γ-ray. Rough threshold measurements indicate that the γ- and β-rays are in cascade. C^{10}, formed by a (pn) reaction in B^{10}, has been carefully re-examined and shown to decay with a $\frac{1}{2}$-life of $19{\cdot}1 \pm 0{\cdot}8$ sec by the emission of $2{\cdot}2 \pm 0{\cdot}1$ MeV positrons and a γ-ray of approximately 1 MeV. The Coulomb energy formula for this type of mirror nucleus is shown to be valid, but the same theoretical difficulties are encountered here as are already known from the long lives of Be^{10} and C^{14}. A.

539.167.3 : 539.164 : 539.165

2098. A study of the radiations from columbium (95), rhenium (188), osmium (191), and osmium (193). MANDEVILLE, C. E., SCHERB, M. V. AND KEIGHTON, W. B. *Phys. Rev.*, **74**, 888–93 (*Oct.* 15, 1948).—The characteristic radiations have been investigated by absorption and coincidence methods. Maximum β-ray energies were determined by Al absorption, and maximum quantum energies were measured by coincidence absorption of the secondary electrons in Al. β-β-, β-γ-, and γ-γ-coincidence rates were measured when possible. Some remarks concerning Sb^{124} and Au^{198} are also included. A.

539.167.3

2099. Search for elements 94 and 93 in nature. Presence of $94Pu^{239}$ in carnotite. GARNER, C. S., BONNER, N. A. AND SEABORG, G. T. *J. Amer. Chem. Soc.*, **70**, 3453–4 (*Oct.*, 1948).—Carnotite (a potassium uranium vanadate), fergusonite (a rare earth uranium columbate-tantalate), and hatchettolite (a uranium columbate-tantalate) were subjected to chemical treatment [Abstr. 3912 (1948)] with the object of isolating elements 93 and 94. The final fractions in each case were examined for α- and β-radioactivity and the probable presence of Pu^{239} in carnotite is indicated to the extent of 1 part in 10^{14}. Fission experiments with slow neutrons and with fast neutrons established the presence of approximately 1 part of 93 or 94 in 10^9. The presence of Pu in carnotite and pitchblende may arise from U^{238} absorbing some of the neutrons emitted in the U spontaneous fission process. W. R. A.

NUCLEAR REACTIONS 539.17

539.17

2100. Some remarks on regenerative uranium piles. RANDERS, G. *Forsvarets ForsknInst. Årb.*, 1–5 (1947) *In Norwegian.*—If n_{235} and n_{238} are the numbers of atoms per cm^3 of U^{235} and U^{238} resp., it is shown that a U pile with ideal moderator becomes regenerative when $n_{235}/n_{238} = 1/150$, if absorption by gradually accumulating fission products is neglected. In practice, the pile must reach regeneration stability before the multiplication factor k (dep. on absorption)

becomes < 1. Losses in the pile are discussed, and the earth's resources of Th and the formation of plutonium are considered. J. A. W.

539.17 : 521.042

2101. On Goldschmidt's abundance distribution of elements. JENSEN, J. H. AND SUESS, H. E. *Naturwiss.*, **34** (*No.* 5) 131–7 (1947) *In German.*—Attempts to provide a theoretical basis for the empirical abundance curve are discussed in a qualitative manner. It is suggested that improved agreement might be obtained from the hypothesis of an expansion and cooling process in prestellar material from a state of high temperature and density and with a strong preponderance of neutrons over protons. R. A. N.

539.17 : 530.145

Notes on Feenberg's series—rearrangements. *See Abstr.* 1697

539.17 : 537.534 : 537.291

2102. Absolute voltage determination of three nuclear reactions. HERB, R. G., SNOWDON, S. C. AND SALA, O. *Phys. Rev.*, **75**, 246–59 (*Jan.* 15, 1949).—A large electrostatic analyser was used in conjunction with an electrostatic generator for absolute voltage determinations of $Li^7(pn)Be^7$ threshold, $Al^{27}(p\gamma)Si^{28}$ resonance, and $F^{19}(p\alpha', \gamma)O^{16}$ resonance. Using absolute volts the values found are 1·882 MeV, 0·9933 MeV, and 0·8735 MeV, respectively. The uncertainties in the measurements appear to be about ±0·1%. A.

539.17 : 537.591.8

Cloud-chamber evidence of a meson-nucleus interaction. *See Abstr.* 1987

539.17 : 539.16

2103. Radioactive Br isotopes. WOODWARD, L. L., MCCOWN, D. A. AND POOL, M. L. *Phys. Rev.*, **74**, 870–5 (*Oct.* 15, 1948).—A radioactive isotope of 2·4-day ½-life has been produced in Br by deuteron bombardment of electromagnetically enriched Se^{76}, and by α-particle bombardment of electromagnetically enriched Se^{74}. Assignment of the isotope is made to Br^{77}. A positron end-point of 0·4 MeV is determined. In addition to annihilation radiation, γ-rays and *K*-capture are observed. The ratio of *K*-capture to positron emission is determined to be 20. The cross-section ratio of the (d, n) to the $(d, 2n)$ reaction producing the isotope is 0·3. The ratio of the sum of the cross-sections for formation of Br^{77} by $Se^{76}(d, n)$ and $Se^{77}(d, 2n)$ to the cross-section for Br^{82} by $Se^{82}(d, 2n)$ is 0·4. A radioactive isotope of 1·7 hour ½-life has been produced in Br by deuteron bombardment and by proton bombardment of enriched Se^{74}. Assignment of the isotope is made to Br^{75}. A positron end-point of 1·6 MeV is determined. *K*-capture is observed in the activity. No γ-ray activity other than that due to annihilation is found. The ratio of *K*-capture to positron emission from the $Se^{74}(d, n)$ reaction is determined to be 4·4. The ratio of the cross-section for formation of Br^{75} by $Se^{74}(d, n)$ to that of Br^{82} by $Se^{82}(d, 2n)$ is 2·1. The 4·4 hour Br^{80} isotope has been produced by a $Se(\alpha, p)$ reaction and found to emit positrons with an end-point of 0·8 MeV. In producing Br^{77} by proton bombardment of Se the (p, γ) reaction is observed to be ⅔ as probable as the (p, n) reaction. A.

539.17 : 539.163

Artificial collateral chains. *See Abstr.* 2069–70

539.17 : 539.166

2104. Disintegration of deuterium by gamma-rays from ^{24}Na. LASSEN, N. O. Letter in *Phys. Rev.*, **74**, 1533–4 (*Nov.* 15, 1948).—The angular distribution of photo-protons from D was measured; long thin cylindrical proportional counters filled with pure D_2 were irradiated by γ-rays from ~ 500 millicuries Na^{24} 30 cm away. Only protons travelling nearly along the counter axis give pulses of maximum size and these are shown to produce a pronounced peak on the pulse height distribution curve for constant θ. The number corresponding to the peak was counted as a function of θ, the angle between the counters and the γ-rays. In the theoretical formula $n_\theta = a + b \sin^2 \theta$, values $a = 0{\cdot}18$ and $b = 0{\cdot}82$ fit the results. The ratio σ_m (photomagnetic cross-section): σ_e (photoelectric cross-section), derived from $a/(a + b)$ is found to be 0·33. Assuming ρ (proton range in deuterium) = 1·5 cm, the absolute cross-section σ total $= 2{\cdot}5 \times 10^{-27}$ cm² ± 20%. T. G. P.

539.17 : 539.166

Radiations from Te^{121}. *See Abstr.* 2087

539.17 : 539.166 : 778.3

2105. The gamma ray spectrum from $F^{19} + H^1$ using photographic emulsions containing D_2O. GOLDHABER, G. Letter in *Phys. Rev.*, **74**, 1725–6 (*Dec.* 1, 1948).—From 30 to 50% D_2O by weight can be introduced into nuclear track emulsions by soaking them in heavy water. This has been used to determine the γ-ray spectrum of the disintegration of F^{19} bombarded with protons into O^{16} and α-particles. D-loaded plates will then display proton tracks due to photo-disintegration. Two peaks of roughly equal intensity were found corresponding to energies of 6 and 7 MeV. W. F. B.

539.17 : 539.167

2106. On the choice between the (d, p) and (n, γ) reactions in the preparation of radiohalogens with a medium-energy cyclotron. SÆLAND, E. *Forsvarets ForsknInst. Årb.*, 269–74 (1947) *In French.*—Results of experimental study of the reactions (d, p) and (n, γ) in preparing Cl^{38}, Br^{80}, Br^{82} and I^{128} with a 6·7 MeV cyclotron are reported. The efficiency of (d, p) decreases in the direction Cl, Br, I, and available activity varies in the opposite sense in the (n, γ) reactions with organohalogen compounds. The $I^{127}(d, p)I^{128}$ reaction gives a high yield even with 6·7 MeV. Purity of the radio-elements is discussed. J. A. W.

539.172

2107. On nuclear disintegrations produced by mesons. HEIDMANN, J. AND LEPRINCE-RINGUET, L. *C.R. Acad. Sci., Paris*, **226**, 1716–18 (*May* 24, 1948) *In French.*—When one of the light nuclei (not Ag or Br) contained in a photographic emulsion undergoes meson capture, the kinetic + binding energy liberated in the resulting star is ~ 25 MeV on the average. From an analysis of the data, using an evaporation model, it is deduced that the disintegrating nucleus is excited to ~ 60 MeV with a temperature of ~ 6 MeV. This suggests that most of the meson mass is set free

in an unobserved way, e.g. as K.E. of a single nucleon travelling too fast to produce a visible track. A. P. F.

539.172

2108. On nuclear disintegrations produced by mesons. HEIDMANN, J. *C.R. Acad. Sci., Paris*, **226**, 1816–17 (*May* 31, 1948) *In French.*—A discussion of various points of detail arising from observations on star disintegrations in nuclear emulsions. [See also Abstr. 2107 (1948)]. A. P. F.

539.172 : 539.163.2

New radioactive isotopes of Tb, Ho, Tm, Lu, Ta, W and Re. *See Abstr.* 2080

539.172.1

2109. Proton bombardment of fluorine. DEVONS, S. AND HEREWARD, H. G. Letter in *Nature, Lond.*, **162**, 331–2 (*Aug.* 28, 1948).—The yield of the (p, γ) capture process in F^{19} was studied between $\sim 0{\cdot}5$ and $\sim 1{\cdot}0$ MeV proton energy, using for detection of the γ-rays the (γ, n) reaction in Cu^{63} (threshold 10·9 MeV). A single resonance at 660 keV was found, with a yield $\sim 2{\cdot}2\%$ of the competing $(p, \alpha\gamma)$ process. The angular distribution of the capture γ-rays was found to be isotropic. A. P. F.

539.172.1

2110. Short-range α-particles from the disintegration of sodium, aluminium and fluorine by protons. FREEMAN, J. M. AND BAXTER, A. S. Letter in *Nature, Lond.*, **162**, 696–8 (*Oct.* 30, 1948).—The yields of short-range α-particles from the reactions $Na^{23}(p, \alpha)Ne^{20}$ and $Al^{27}(p, \alpha)Mg^{24}$ were measured as a function of proton energy from 400 to 960 keV. Several resonances were observed for each process. The α-particles were magnetically separated from scattered protons and their ranges determined. In a comparison study of the reaction $F^{19}(p, \alpha)O^{16*}$, two α-particle groups were observed, corresponding to formation of the O^{16*} in γ- and pair-emitting states respectively, with an energy difference of $0{\cdot}16 \pm 0{\cdot}02$ MeV. A. P. F.

539.172.1

2111. Disintegration of Boron-10 by protons. BURCHAM, W. E. AND FREEMAN, J. M. Letter in *Nature, Lond.*, **163**, 167 (*Jan.* 29, 1949).—The reaction $B^{10}(p, \alpha)Be^7$ has been observed using apparatus previously described. The energy release was found to be $1{\cdot}04 \pm 0{\cdot}06$ MeV from the range, and $1{\cdot}05 \pm 0{\cdot}07$ MeV from the momentum of the α-particles. B. R.

539.172.1 : 539.165

2112. Observations associated with the reaction $B^{11}(d, p)$. HUDSPETH, E. L. AND SWANN, C. P. Letter in *Phys. Rev.*, **74**, 1722 (*Dec.* 1, 1948).—The β-ray yield (from decay to C^{12} of the B^{12} produced) was measured over the range 0·25–1·8 MeV bombarding energy. No resonances were found. The best fit of the yield curve to a Gamow penetration formula was obtained for an assumed energy release of 0·1 MeV in the reaction. From the range of the protons, an energy release of 0·15 MeV was deduced. β-γ coincidence measurements suggested the formation of the C^{12} in an excited state. A. P. F.

539.172.1 : 539.167.3

2113. Tc^{92} and Tc^{93} by relative cross-section measurements. KUNDU, D. N. AND POOL, M. L. *Phys. Rev.*, **74**, 1775–81 (*Dec.* 15, 1948).—Under 5 MeV proton and 10 MeV deuteron bombardments on natural Mo and on electromagnetically enriched Mo isotopes, activities of 2·7 hr, 47 min, and 4·5 min ½-lives are found to be produced from Mo^{92}. The relative cross-sections for the production of these activities are 25 : 127 : 1, respectively. On comparing these figures with those for the (p, n):(p, γ) reactions from Mo^{93}, the 47 min activity is assigned to Tc^{92}, and the 2·7 hr and the 4·5 min activities to Tc^{93}. Tc^{92} decays by K-capture only attended with 1·5 MeV γ-rays. For the 2·7 hr Tc^{93}, the decay is 93% by K-capture and 7% by emission of positrons of maximum energy 0·83 MeV. There are also γ-rays of energy 2·0 MeV associated with this activity. A.

539.172.11 : 539.164

2114. The formation of U^{232} by helium ions on thorium. NEWTON, A. S. Letter in *Phys. Rev.*, **75**, 209–11 (*Jan.* 1, 1949).—By measuring the $_{92}U^{232}$ ($\tau_{\frac{1}{2}} = 70$ yr) activity in the surface layers of a Th sample 6 months after bomb. with 39 MeV α-particles, the total cross-section for the reactions $_{90}Th^{232}(\alpha, 4n)_{92}U^{232}$, $_{90}Th^{232}(\alpha, p3n)_{91}Pa^{232}(\tau_{\frac{1}{2}} = 1{\cdot}4$ days; $\xrightarrow{\beta^-}{}_{92}U^{232})$ has been determined as 13·2 millibarns at an average α-particle energy of 37·5 MeV, and the threshold energy lies between 28 and 31·6 MeV. A. O. S.

539.172.21

2115. Argon and neon (pn) thresholds. RICHARDS, H. T. AND SMITH, R. V. Letter in *Phys. Rev.*, **74**, 1870–1 (*Dec.* 15, 1948).—An attempt has been made to determine the neutron threshold for the reaction $A^{40}(pn)K^{40}$ for which mass values give $Q = -1{\cdot}1 \pm 1{\cdot}1$ MeV. The threshold could not be determined due to too low a yield at low energies, but a sharp rise in the neutron yield was found at 2·4 MeV proton energy. A search for a (pn) threshold in Ne gave negative results. G. O. B.

539.172.21

2116. Deuterium (pn) threshold. SMITH, R. V. AND RICHARDS, H. T. Letter in *Phys. Rev.*, **74**, 1871–2 (*Dec.* 15, 1948).—Bombardment of D gas with protons has shown that it may be possible to obtain an accurate value of the binding energy of the deuteron by this method, according to the equation $D + H \rightarrow 2H + n + Q$. G. O. B.

539.172.3

2117. On the photodisintegration of Be^9_4. BORSELLINO, A. *Nuovo Cim.*, **5**, 263–73 (*Aug.*, 1948) *In Italian.*—The variation of cross-section with energy for the photo-disintegration of Be^9 is calculated using a two-body model and a rectangular potential well. Reasonable agreement is obtained with experiment. U. C.

539.172.3

2118. On the formation of shielded isobars by the nuclear photo-effect. SMART, J. S. Letter in *Phys. Rev.*, **74**, 1882 (*Dec.* 15, 1948).—A study of shielded isobars (those having 2 units of charge more than their partners, and thus not to be reached by a single β-process) shows that their abundance is ~ 40 times more when they are derivable by a (γ, n) process from a nucleus with an odd no. of neutrons than

when derivable from a nucleus with an even no. of neutrons. This supports the view that their formation was by nuclear photo-effect; a temp. of $\sim 0{\cdot}1$ MeV during an early stage in the formation of the elements [Abstr. 2933 (1948)] would account for the absolute size of the observed abundances. A. P. F.

539.172.4 : 539.185

2119. Theory of oscillating absorber in a chain reactor. Weinberg, A. M. and Schweinler, H. C. *Phys. Rev.*, **74**, 851–63 (*Oct.* 15, 1949).—The response of a critical chain-reacting pile to a thermal neutron absorber which is oscillated back and forth inside the pile is calculated. It is shown that at frequencies which are low compared to the periods of delayed neutrons, the neutron intensity in the pile rises and falls as a whole, the shape of the stationary distribution always being maintained. As the frequency of the oscillation increases, the nature of the neutron response changes from the over-all fluctuation characteristic at low frequency to a propagated and attenuated neutron wave which emanates from the neighbourhood of the oscillator. These neutron waves set up at high frequencies are entirely analogous to the familiar thermal waves which are established in Angstrom's method of measuring thermal conductivities. It is pointed out that since the pile equations are linear, the amplitude of the oscillating response is proportional to the total neutron absorption of the oscillated absorber, and therefore a known and an unknown absorber can be compared by observing the magnitude of the neutron oscillations caused by each. A.

539.172.4 : 539.185

2120. Measurement of neutron absorption cross sections with a pile oscillator. Hoover, J. I., Jordan, W. H., Moak, C. D., Pardue, L., Pomerance, H., Strong, J. D. and Wollan, E. O. *Phys. Rev.*, **74**, 864–9 (*Oct.* 15, 1948).—The paper deals with the measurement of thermal neutron cross-sections by a technique referred to as the pile oscillator. In this method, a neutron absorber is moved back and forth in a field of thermal neutrons such as that existing in a chain reactor. In the vicinity of the absorber there is a depression in the neutron flux and the motion of this depression past a nearby ion chamber produces an oscillating signal whose amplitude is proportional to the total neutron absorption cross-section of the sample. In the instrument considered here, the oscillating signal generated in the ion chamber is amplified, rectified, and fed to an integrating circuit. The absorption cross-section of an unknown sample is determined by comparing the charge accumulated in the integrating circuit with that produced by a standard gold absorber. The instrument will detect a total absorption cross-section of about 10^{-3} cm^2 and hence it is suitable for measuring cross-sections of separated isotopes which are available only in small quantities. One of the major difficulties in making this instrument useful for absorption measurements has been the elimination of the effects of scattering by the sample. It was found that the signals caused by absorption and scattering are slightly out of phase with each other, and by properly phasing the rectifier, absorption cross-sections which are no greater than 1% of the corresponding scattering cross-sections can be measured. A number of thermal cross-section measurements have been made with this instrument, most of which will be published separately, as illustrations, the following thermal cross-sections are given: In, $191{\cdot}2b$; Ag^{107}, $29{\cdot}9b$; Ag^{109}, $83{\cdot}7b$ ($1b = 10^{-24}$ cm^2). A.

539.172.44 : 539.166.2 : 539.152.1

2121. Experimental upper limit for the mean life of the 478·5 keV excited state of Li^7. Elliott, L. G. and Bell, R. E. Letter in *Phys. Rev.*, **74**, 1869–70 (*Dec.* 15, 1948).—An investigation has been carried out of the γ-ray accompanying the reaction $B^{11}(n, \alpha)Li^7$. The γ-ray arises from the excited Li^7 nucleus and was studied by analysing the photo-electrons emitted from a $7{\cdot}2$ mg/cm^2 Au foil. The energy of the γ-ray was found to be $478{\cdot}5 \pm 1{\cdot}5$ keV. By comparison with the shapes of the K photo-electron lines produced by the γ-rays from Au^{199} and ThC″, an upper limit for the mean life of the Li^7 excited state is found to be $2{\cdot}0 \times 10^{-13}$ sec which agrees reasonably well with a value calculated from the interaction of the magnetic moment with the radiation field. G. O. B.

ATOM AND MOLECULE BEAMS
MESONS . NEUTRONS 539.18

539.18

2122. On the momentum distribution of the decay electrons from negative mesons. Primakoff, H. *Phys. Rev.*, **74**, 878–82 (*Oct.* 15, 1948).—The momentum distribution of decay electrons from negative mesons bound in K-orbits is calculated assuming a 2-particle disintegration of the meson into an electron and a neutrino or neutretto. The resultant momentum distribution has a spread of $\sim Z/137p_e^{(0)}$, where $p_e^{(0)}$ is the momentum of the decay electron from a free and stationary meson. The effect of the meson's binding on its mean life for decay is also considered and a small decrease in the mean life, by a factor of $\sim (Z/137)^2$, is found. A.

539.18

2123. On the absorption of negative mesons. Clementel, E. and Puppi, G. Letter in *Nuovo Cim.*, **5**, 505–6 (*Oct.*, 1948) *In Italian.*—The hypothesis that a μ^--meson absorbs a neutretto, transforming itself to a π^--meson before being absorbed by a nucleus, leads to the correct order of magnitude for the $\frac{1}{2}$-life of the capture process. U. C.

539.18

2124. On the range of decay electrons from mesons. Shamos, M. H. and Russek, A. Letter in *Phys. Rev.*, **74**, 1545 (*Nov.* 15, 1948).—Using a delayed coincidence circuit and cylindrical C absorber, the residual range of the decay electrons from μ-mesons has been measured. The experimental results are not consistent with a unique decay energy for the electrons. U. C.

539.18

2125. On the light and heavy mesons. Lopes, J. L. Letter in *Phys. Rev.*, **74**, 1722–3 (*Dec.* 1, 1948).—

Assuming Fermi coupling of μ-mesons with nucleons and also with electrons and neutrinos, and using the knowledge of nucleon-π-meson coupling obtained from nuclear force theory, estimates of the lifetime for the process $\pi \rightarrow \mu + \mu_0$ are obtained for 2 values of m_π/m_μ. The suggestion [Abstr. 3454 (1948)] that μ-mesons may be excited states of electrons is criticized on the ground that one would expect, but does not observe, a corresponding fine structure of proton masses. [See also Abstr. 2946 (1948)]. A. P. F.

539.18 : 530.14

The Lorentz transformation and the mass problem. *See Abstr.* 1684

539.18 : 530.145

Field mechanical derivation of Dirac's wave-equation. *See Abstr.* 1698

539.18 : 530.145

Mechanics and mass-spectrum of fundamental particles. *See Abstr.* 1699

539.18 : 530.145

On the mesic charge. *See Abstr.* 1700

539.18 : 537.591

2126. On the local generation of slow mesons. CORTINI, G., MANFREDINI, A. AND PERSANO, A. Letter in *Nuovo Cim.*, **5**, 507 (*Oct.*, 1948) *In Italian.*—The ratio of the number of mesons stopping in a photographic emulsion to the number of "stars" observed in the same volume is shown to increase by a factor 3 between 2 800 m and 23 000 m. The suggestion is offered that the spectrum of the mesons locally produced by the primary component shows a strong maximum at low energies—in accord with the hypothesis of the multiple production of mesons in the collisions between nucleons. U. C.

539.18 : 537.591

Generation of slow mesons. *See Abstr.* 1969

539.18 : 537.591

Cosmic ray mesons. *See Abstr.* 1970–1

539.18 : 537.591

Decay of mesons. *See Abstr.* 1972–3

539.18 : 539.152.1

2127. On the atomic capture of slow mesons. FERRETTI, B. *Nuovo Cim.*, **5**, 325–67 (*Aug.*, 1948) *In Italian.*—Calculations for the time of capture by atoms of slow negative mesons are made, in order to examine the results of the delayed coincidence experiments. Qualitative agreement with the results of Fermi and Teller is obtained although different hypotheses are used. U. C.

539.181 : 537.534

2128. Experimental determination of rate of energy loss for slow H^1, H^2, He^4, Li^6 nuclei in Au and Al. WILCOX, H. A. *Phys. Rev.*, **74**, 1743–54 (*Dec.* 15, 1948).—A description is given of the use of a variable energy source of monoenergetic H^1, H^2, He^4, Li^6 nuclei, an energy analyser, and an electron multiplier tube to measure the decrease in energy of these particles as they pass through Au foil of known thickness; the measurements are carried out for protons from an energy of 30 to 400 keV, for deuterons from 30 to 650 keV, for alpha-particles from 30 to 1 400 keV, and for the Li^6 nuclei from 750 to 850 keV. Similar measurements are carried out for the energy loss of protons and deuterons in Al over the energy range from 60 to 300 keV. Integrated range-energy curves are given for these low energies. Although current theory predicts that the energy loss rates will be precisely equal for protons and deuterons of the same velocity, it is found that the loss rate for deuterons of low velocity is a few % higher than that for protons of the same velocity. A qualitative explanation for the discrepancy is advanced. A.

539.185

2129. The scattering of fast neutrons by protons. POWELL, C. F. AND OCCHIALINI, G. P. S. *Rep. Internat. Conf.* "*Fundamental particles*" (1946) (*Phys. Soc., Lond.*) **1**, 150–66 (1948).—Observations have been made on the scattering of fast neutrons by protons, using the "half-tone" photographic emulsion for the detection of the recoil protons. The precision of the measurements has been improved, (*a*) by making exposures in conditions of refined geometry with emulsion 150 μ thick, and (*b*) by developing empirical methods of correcting for the escape of tracks from the emulsion, taking into account the small angle Coulomb scattering of the protons which result from collisions with the nuclei of Ag and Br atoms in the emulsion. This latter problem is important in connection with the application of the photographic method to the study of disintegrations produced by the very energetic particles now being generated artificially. If $I(\phi)$ represents the intensity, in the centre-of-mass co-ordinate systems, of the neutrons scattered by protons through the angle ϕ, the observed ratio $I(\pi)/I(\pi/2)$ is equal to $1{\cdot}1 \pm 0{\cdot}1$ for 9 MeV neutrons and $1{\cdot}2 \pm 0{\cdot}2$ for 13 MeV neutrons. A.

539.185

2130. The diffusion length of thermal neutrons in boric acid solutions and the ratio of the capture cross-sections of boron and hydrogen. REEL, H. L. AND GROSJEAN, C. *C.R. Acad. Sci., Paris*, **226**, 1598–600 (*May* 19, 1948) *In French.*—Using a technique already described [Abstr. 192 (1948)], the diffusion length was measured as a function of B concentration in aqueous solutions of H_3BO_3. The ratio of B and H capture cross-sections was deduced to be $2\,180 \pm 65$. A. P. F.

539.185 : 537.13 : 530.145

The magnetic moment of the neutron. *See Abstr.* 1701

539.185 : 537.591.15

Neutrons in cosmic-ray showers. *See Abstr.* 1982–3

539.185 : 539.152.1

2131. Scattering and absorption of neutrons by polarized nuclei. ROSE, M. E. Letter in *Phys. Rev.*, **75**, 213–14 (*Jan.* 1, 1949).—The scattering of polarized S neutrons by nuclei with spin is discussed. The change of scattering cross-section attainable in practice (through the orientation effect) is estimated as $\sim$ 10–30% from which the phase shift due to polarization could be found. A study of the dependence of capture cross-section on polarization is also suggested, as this should give information on angular momentum of the compound nucleus. The angular distribution of γ-rays from polarized nuclei would also be of interest. [Abstr. 2917 (1948)]. A. P. F.

539.185 : 548.0 : 537

2132. The effect of crystal orientation on the scattering of slow neutrons. ARNOLD, G. P., MYERS, V. W. AND WEBER, A. H. *Phys. Rev.*, **75**, 217–20 (*Jan.* 15, 1949).—A simple theory is developed taking into account non-random orientations in microcrystalline material of the hexagonal system. The transmission of slow neutrons through extruded and powdered graphite is measured experimentally and compared with theory. A.

539.185 : 614.8 : 539.16.08

2133. Tolerance flux of thermal neutrons. CAPRON, P., FAES, M. AND TAVERNIER, G. C. Letter in *Nature, Lond.*, **163**, 129 (*Jan.* 22, 1949).—Measurements were made, using Rh detectors, on the distribution within a paraffin block (simulating the body) of resonance and thermal neutrons produced by a Ra–Be source at 50 cm. The ionization near the surface is as much as 3× that calculated assuming the body to be a semi-infinite medium with an exponential distribution of neutrons. A. P. F.

539.185.9 : 542.952

2134. Polymerization of styrene induced by slow neutrons. LANDLER, I. AND MAGAT, M. *C.R. Acad. Sci., Paris*, **226**, 1720–1 (*May* 24, 1948) *In French.*—Styrene is polymerized by the action of slow neutrons in the presence of ethyl bromide, both Br and H contributing to the Szilard effect. The polymer contains bound radioactive Br. The number of initiating centres necessary for the observed polymerization is 100–1 000× > the number of centres produced by the Szilard effect. Possible mechanisms for the formation of secondary centres are suggested. C. B. A.

STRUCTURE OF SOLIDS 539.2

539.211

2135. Attempt to determine the orientation of the elementary facets of a superfinished surface. BLET, G. *Ric. Sci. Ricostruz.*, **18**, 1291–7 (*Oct.*, 1948) *In French.*—Light is reflected only by facets whose normals bisect the angle between source and observer; this condition is expressed in terms of angles convenient for the study of a cylinder. A cylinder of dural was photographed after various techniques of finishing, and photometric measurements across the reflecting band are correlated with the distribution of facets to be expected from the technique. A. J. C. W.

539.213 : 666

2136. On the structure of glass. STANWORTH, J. E. *J. Soc. Glass Tech.*, **32**, 154–72 (*June*, 1948).—The paper discusses certain criteria for glass formation in pure oxide and in complex oxide glasses, and stresses the importance for the glass-forming cation of a low co-ordination number and ability to form covalent bonds to oxygen. Glasses containing alumina as a principal glass-forming cation are described, and some of their physical properties discussed. It is suggested that the possibility of making glasses containing high percentages of Pb, Bi and Tl is connected with the presence of an outer shell of (18 + 2) electrons. The role of many other cations i also discussed. A

539.214 : 539.219.1

2137. Fundamental equations of consolidation of the soil. FLORIN, V. A. *Dokl. Akad. Nauk, SSSR*, **5** (*No.* 1) 21–4 (1948) *In Russian.*

539.215.4 : 537.531 : 535.4

2138. Particle size determination by soft X-ray scattering. YUDOWITCH, K. L. *J. Appl. Phys.*, **20** 174–82 (*Feb.*, 1949).—Small angle X-ray scattering measurements are made on samples of colloidal Au of radius 50–400 Å. Cu (1·54 Å) and Al (8·32 Å radiation are used. The usual method of analysis i shown to be valid only for particles of radius < 12 wavelengths. Extension of the method to large particles is achieved, giving improved electron microscope correlation. The use of longer wave lengths and optimum shaped slits are shown t reduce geometry errors sufficiently to give clea evidence of predicted intensity maxima. The firs 3 secondary shape function maxima are observed An additional interference maximum attributable t particle-to-particle interference is observed. The position and magnitude of this maximum are correctly predicted by an expression based on earlier fluid scattering theory. A

539.216.1 : 553.621

2139. Reproducible construction of quartz fiber devices. KIRK, P. L. AND CRAIG, R. *Rev. Sci. Instrum.*, **19**, 777–90 (*Nov.*, 1948).—Methods for construction of various types of quartz fibre structures by means of jigs also made from small quartz rod are described. It is shown that the advantages of jig construction are in obtaining a better product and particularly the ability to reproduce quite accurately a number of such quartz structures. Various practical aspects of quartz fibre manipulation and construction are discussed. A

539.217

2140. Photo-density method of determining the relative penetration of diffused sodium 24 tracer into glass. JOHNSON, J. R. *J. Appl. Phys.*, **20**, 130–40 (*Feb.*, 1949).—A photo-density method for the determination of diffusion of radioactive tracer is presented and compared in detail to a thin section analysis method. The method is applicable to similar tracer problems such as metal diffusion studies. The analysis of an emulsion exposed by decaying Na^{24} which had been allowed to diffuse into glass is given. The necessity for making and using an emulsion gamma-curve for the tracer in this analysis is shown. A.

539.218 : 513.468

Density and packing in an aggregate of mixed spheres. *See Abstr.* 1619

539.23 : 541.124 : 620.191.5

2141. Tarnishing and related phenomena. EVANS, U. R. *Proc. 3rd Internat. Electrodepos. Confr. (London*, 1947) (*Electrodepos. Tech. Soc.*) 179–84 (1948).—The growth of oxide or sulphide films on metals may obey various laws, namely, where cracks, pores or other cavities appear, parabolic, rectilinear, or logarithmic equations may govern growth, but in the absence of such complications, the relation between

thickness y and time t is most simply expressed as $dy/dt = k, y$, where the constant, k, is related to the electrical properties of the film-substance by Wagner's equations. These show that films of high electrical resistance (e.g. beryllia or alumina) should resist film-growth; electronic and ionic conductivity are both needed if the film is to thicken quickly. Sulphides contain more lattice defects than oxides, and the presence of S in a film reduces its protective properties; metals which undergo no visible change when exposed to pure air at ordinary temperatures may tarnish readily if S compounds are present. At high temperatures the oxidation-rate, although appreciable in the absence of S, is increased if the atmosphere contains S compounds. The resistance of a Cu–Al alloy to oxidation at high temp. or of a Ag–Cu–Al alloy to tarnishing in polluted air at ordinary temp., is greatly improved if the alloy has received a preliminary treatment designed to develop an invisible film of pure alumina (free from Cu and/or Ag) on the surface. H. H. HO.

539.231 : 537.52

2142. Application of gas discharge to aluminizing of glass surfaces. ROZHDESTVENSKI, V. N. *J. Tech. Phys., USSR*, **18**, 579–84 (*May*, 1948) *In Russian.*

539.234

2143. Production of extremely thin metal films by evaporation on to liquid surfaces. HAST, N. Letter in *Nature, Lond.*, **162**, 892–3 (*Dec.* 4, 1948).—Using acrylates instead of cellulose nitrate and collodion for the basic film on to which thin metal films for electron microscopical use were evaporated [*Nature*, **159**, 370–1 (1947)] no faint structure effect was visible. The solvent for the basic film was ethyl acetate. The procedure for making Be or Al films, 10–20 Å thick, by evaporation *in vacuo* on to a glycerol surface, is described. The method is suitable for any liquid with high boiling point, and low vapour pressure at room temperature. Metals evaporated on to oils do not form films. For Al evaporated *in vacuo* on to a Hg surface no reaction took place. S. W.

539.26

2144. Behaviour of stressed aluminium at room temperature. OWEN, E. A., LIU, Y. H. AND MORRIS, D. P. *Phil. Mag.*, **39**, 831–45 (*Nov.*, 1948).—An X-ray study was made of the behaviour of Al (either 99·998% purity, or else in an alloy) after the removal of stresses. The experimental results are presented in the form of curves showing the variation with time of the lattice parameter, after the removal of stress. This is done both for Al in plate form and Al in powder form. The mean value of the lattice parameter obtained from annealed powder samples is 4·0406 kX at 18°C. Similar curves are given for the Al–Pb and Al–Ga alloys, these being taken since Ga is soluble, Pb insoluble in Al. The effects of filed surfaces and polished surfaces are noted. L. S. G.

539.26 : 539.4.016 : 539.374

2145. X-ray line broadening in cold-worked metals. PATERSON, M. S. AND OROWAN, E. Letter in *Nature, Lond.*, **162**, 991–2 (*Dec.* 25, 1948).—Cu and Al wires were plastically deformed by twisting, and the X-ray line breadths were measured in the back-reflection region. Experiments were made both at room temp. and at the temp. of liquid N_2. The line-breadths increased progressively with shear, not reaching a limit, were greater for the low-temp. deformation, and on deformation first at one temp. and then at the other, tended towards those characteristic of the second temp. The smaller breadth from room-temp. deformation is not due to recovery, as the low-temp. breadth does not diminish immediately on warming up. (Al showed partial recovery in a period of weeks.) The results favour the theory that line-broadening is due chiefly to stresses varying up to the macroscopic yield stress. A. J. C. W.

539.26 : 541.18

2146. The structural types of aqueous systems of surface-active substances and their X-ray diffraction characteristics. MCBAIN, J. W. AND MARSDEN, S. S., JR. *Acta Cryst.*, **1**, 270–2 (*Nov.*, 1948) *In English.*—Summarizes the available information on X-ray diffraction by aqueous systems of detergents and colloidal electrolytes and suggests a classification of their structures based on a division into two broad classes—liquid crystalline and isotropic. The first class is subdivided into expanding lamellar, non-expanding lamellar and fibrous; and the second into diffracting lamellar with long and short spacings, diffracting lamellar with short spacings only, and non-diffracting. J. T.

539.264 : 669.018 : 539.215

2147. Analyses and interpretations of X-ray diffraction effects in patterns of aged alloys. GEISLER, A. H. AND HILL, J. K. *Acta Cryst.*, **1**, 238–51 (*Nov.*, 1948) *In English.*—The limitations of the various X-ray diffraction methods which have been used to study the structure of aged alloys are discussed. A method which employs a stationary single crystal and characteristic radiation is described. The method is applied to the structures in aged Al–Ag and Al–Mg–Si alloys. Evidence for 1- and 2-dimensional diffraction is reported for both alloys. Limitation of particle dimensions is proposed as a general explanation of the diffraction effects; this is the most suitable explanation for patterns of Al–Mg–Si alloys. Reciprocal-lattice points for thick particles of the precipitate structure evolve from rods for thin platelets, and evolve earlier from planar areas in the reciprocal lattice corresponding to particles that have only one resolvable dimension. A change in structure to that of the precipitate has occurred at the earliest detectable stage. Indefinite periodicities in the matrix structure cannot account for the data for either this alloy or for a previously studied Al–Mg alloy. The interpretation based on particle size is also adequate for other alloy systems, such as Al–Cu and Al–Ag, in which the diffraction effects of the precipitate are more intimately related to those of the matrix. The existence of predominantly 1-dimensional particles prior to the platelike particles in the sequence of growth is identified. This is a new concept in the theory of the precipitation process. A.

539.27

2148. The electron-micrographic structure of shadow-cast films and surfaces. WILLIAMS, R. C. AND BACKUS, R. C. *J. Appl. Phys.*, **20**, 98–106 (*Jan.*, 1949).—The lower limit of size of objects which can be photographed by the aid of shadow-casting is shown to

depend upon the smoothness of substrate upon which they can be mounted, and upon the continuity of structure of the thin shadowing films. Numerous attempts to produce smoother substrate films and films for shadow-casting of high efficiency and continuity of structure are reported. No success has been encountered in producing a usable film perceptibly smoother than the collodion and Formvar commonly used. It is found that the best shadow-casting material for this type of film is U or UO_2. The severe granulation of Au films when subjected to the electron current of a biased-beam electron gun is confirmed. Attempts to reduce this to a satisfactory level have failed. Various methods of preparing pre-shadowed replicas are reported. The factors affecting the tenacity of evaporated films to glass surfaces are discussed. Elements which oxidize readily are relatively adherent to glass, while the elements Au, Pd, Pt, Rh are not. A Pd–Pt mixture is the most satisfactory material for the pre-shadowed replica technique, and ~ 6 Å films produce adequate shadows with no sign of granulation. The surface of clean glass is found to have the smoothest structure of any material, with practically no sharp discontinuities in elevation $\geqslant 10$ Å. An appendix is given, in which technical details of shadow-casting and replica production are described. A.

539.27 : 531.717 : 621.385.833

2149. Length and thickness measurements in the electron microscope. MAHL, H. *Arch. tech. Messen, Issue No.* 156 (*V*1121-7) (*Aug.*, 1948) *In German.*—Discusses the possible errors which may arise in measurements of particle size and specimen thickness by the electron microscope, and outlines the precautions to be taken in making such measurements. A full bibliography is appended. J. T.

539.27 : 537.533.9

2150. Changes in organic preparations in the electron-microscope. KÖNIG, H. *Nachr. Wiss. Göttingen* (*No.* 1) 24–5 (1946) *In German.*—When collodion films are used as carriers in electron-microscope investigations they become insoluble in amyl acetate, and are not affected by high temp. These changes have been more fully investigated. Electron-diffraction experiments show that the fresh collodion film gives 3 weak rings. On irradiation with electrons the innermost ring disappears. After tempering in vac. at 1 000° the scattering pattern of graphite is obtained. The 2-ringed pattern obtained by irradiation with electrons corresponds with the diagram for fine-cryst. graphite. The collodion film is thus converted into graphite by irradiation with electrons. B. A.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.3 : 534.22

2151. An investigation of the dynamic elastic properties of some high polymers. HILLIER, K. W. AND KOLSKY, H. *Proc. Phys. Soc., Lond. B*, **62**, 111–20 (*Feb.*, 1949).—An apparatus for the investigation of the transmission of sound along filaments at frequencies between 1 000 and 6 000 c/s is described, both for unstrained specimens and specimens elongated at a constant rate of increase of strain. Measurements of the dynamic elasticity and damping factors of filaments of polythene, neoprene and nylon have been obtained, and the correlation of these results with the molecular re-arrangements which take place during stretching is discussed. A.

539.3 : 535.55

Mathematical theory of photo-viscoelasticity. *See Abstr.* 1850

539.32

2152. Elastic constants of beta-brass. LAZARUS, D. Letter in *Phys. Rev.*, **74**, 1726–7 (*Dec.* 1, 1948).—Measurements on large single crystals by ultrasonic technique of C_{11}, C_{12}, C_{44} lead to calculated values of shear modulus and compressibility in good agreement with directly measured values, and suggest that earlier results on these constants were in error. Observed variation of Young's modulus with direction is fairly well accounted for by present data. Coupling between torsional and flexural modes in earlier experiments is suggested as a source of error. N. F. A.

539.32 : 534.321.9

2153. Determination of the elastic constants of solids by ultrasonic methods. SCHNEIDER, W. C. AND BURTON, C. J. *J. Appl. Phys.*, **20**, 47–58 (*Jan.*, 1949).—The application of ultrasonic methods to the determination of the elastic constants of solids is considered in some detail. It is shown that a rotating plate technique in which ultrasonic transmission is plotted as a function of the angle of incidence of the waves allows determination of the velocities of dilatation and shear waves in the plate. From these data, Poisson's ratio and the mechanical moduli may be determined. Details of an apparatus for making such measurements are given. The elastic constants of several metals have been measured with this equipment and the values obtained are shown to be in agreement with previous published data. In addition, measurements of a number of thermoplastic and thermosetting resins have been made successfully. A.

539.32 : 679.5

2154. Some "temperature-Young's modulus" relationships for plastics. MOLL, H. W. AND LEFEVRE, W. J. *Industr. Engng Chem.*, **40**, 2170–9 (*Nov.*, 1948).—The variation of Young's modulus with temperature for any given plastic material is useful in evaluating the suitability of that material for certain applications. A laboratory apparatus is described, which makes possible the accurate and efficient determination of the relationship between temperature and Young's modulus for a wide variety of plastic materials and sample sizes. Data for a number of plastics have been compared with impact and service data and are reported in this paper. A.

539.32 : 548.0 : 534.22

2155. Elastic behaviour of quartzite and fused quartz. SUNDARA RAO, R. V. G. *Proc. Indian Acad. Sci. A*, **28**, 185–8 (*Oct.*, 1948).—Effective elastic constants of quartzite have been computed from determinations of the velocities of an ultrasonic wave along 3 orthogonal directions. Velocities and elastic constants are the same in the 3 directions. Since the velocity in fused quartz is practically equal to that in quartzite

is concluded that quartz grains are randomly riented in quartzite. W. R. A.

539.32.08 : 620.17.05

156. Design of devices used in the study of stress-train-time properties. MOREY, D. R. *Text. Res. J.*, **5**, 267–73 (1945).—The design of loading devices iving, e.g., constant stress, or constant rate of stress ncrease, and utilizing chain loads unwrapping from ylinders or cams, is discussed.

539.37 : 548.0

157. On the equations of motion of crystal dis-ocations. FRANK, F. C. *Proc. Phys. Soc., Lond. A*, **2**, 131–5 (*Feb.* 1, 1949).—It is shown that when a Burgers screw dislocation moves with velocity v it uffers a longitudinal contraction by the factor $(1 - v^2/c^2)^{\frac{1}{2}}$, where c is the velocity of transverse ound. The total energy of the moving dislocation s given by the formula $E = E_0/(1 - v^2/c^2)^{\frac{1}{2}}$, where E_0 is the potential energy of the dislocation at rest. Taylor dislocations behave in a qualitatively similar manner, complicated by the fact that both longi-udinal and transverse displacements and sound elocities are involved. A.

539.373 : 548.0

158. On the distribution over the volume of metal rystals of deformations produced by slip. KURNOSOV, D. G., TRONINA, N. M. AND JAKUTOVICH, M. V. *J. Tech. Phys., USSR*, **18**, 197–206 (*Feb.*, 1948) *In Russian.*—An experimental investigation, by studying he topography of the cuts of deformed mono- and olycrystal specimens by the micro-interference nethod. It was shown that at low degrees of deforma-ion only the smaller part of the deformations pro-uced is concentrated on the slip packets, whilst the reater part is distributed over the whole crystal olume. B. F. K.

539.374

159. Plastically deformable alloys with high oercive force. LIFSHITZ, B. G. *Izv. Akad. Nauk, SSR (Ser. Fis.)* **12** (*No.* 2) 116–20 (1948) *In Russian.*—A survey of recent literature. D. S.

539.374

160. The determination of stresses in plastic regions n problems of plane flow. SYMONDS, P. S. *J. Appl. Phys.*, **20**, 107–11 (*Jan.*, 1949).—A simple numerical-raphical method for the calculation of stresses in lastic zones adjacent to boundaries of arbitrary hape is outlined, applicable to problems of plane lastic flow in ideally plastic materials. For illustra-ion, the method is applied to determine the stresses n plastic zones near elliptic free boundaries. The ield load of a tensile bar containing elliptic notches s obtained for a series of notches of varying sharpness. ome related problems are discussed briefly. A.

539.374 : 539.4.016 : 539.26

X-ray line broadening in cold-worked metals. *ee Abstr.* 2145

539.382

161. Stress-strain rate relations for anisotropic lastic flow. DORN, J. E. *J. Appl. Phys.*, **20**, 15–19 *Jan.*, 1949).—A simple theory for stress-strain rate nalyses during plastic flow of anisotropic sheet metals s proposed for the work hardening range. The effect f orientation on the yield strength in simple tension and biaxial tension is discussed for various types of symmetry. The theory appears to be approximately correct for mild steel plates that exhibit planar isotropy. A.

539.382 : 53.081.5

2162. On the dimensions of physical magnitudes (Seventh paper: A paradox in dimensional theory). DINGLE, H. *Phil. Mag.*, **40**, 94–9 (*Jan.*, 1949).—The theme developed in previous papers [Abstr. 22 (1947)] is applied to the problem of dimensions of the quantity, ψ, given in the form, $\psi = S^{\beta}\sigma^{-1}t^{k}$, by Nutting, where S is the stress, σ the strain of a material which is neither a Hookean solid nor a Newtonian fluid; and also to the recent work of Scott-Blair [Abstr. 1019 (1947)]. It is concluded that, with the new outlook developed in previous papers, there is no objection to Scott-Blair's work on dimensional grounds. L. S. G.

539.382 : 534.2

2163. Some theoretical considerations on the dynamic properties of plastics. ASTBURY, N. F. *Proc. Roy. Soc. A*, **196**, 92–105 (*Feb.* 22, 1949).—The marked similarity between the mechanical behaviour of plastics and the electric behaviour of certain dielectrics provides a starting-point for the derivation of a mechanical stress-strain relationship for plastic materials, from which expressions are deduced for the velocity of sound in, and the transmission and reflection of sound by, plastic plates. The effect of absorption on departures from Rayleigh's theory is indicated, and limited experimental data are reported. A.

539.382 : 539.501

Anomalous stress-strain relations. *See Abstr.* 2172

539.383 : 548.0

2164. The nature of the dissipative forces at small displacements of surfaces in contact. SCHEMBEL, B. K. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 9) 1567–70 (1948) *In Russian.*—The author investigated the behaviour of piezo-quartz by studying the dissipative pressure component, by simply measuring the equivalent resistance of an auto-regenerative quartz oscillator circuit, a method that assures a high degree of accuracy. The method rests on the fact that the damping introduced by the compression of the crystal amounts to 200–300% of the natural damping of the crystal, so that even small relative changes of the value of the dissipative forces of interaction tell heavily on the equivalent resistance of the crystal. The resistance-pressure curve obtained for a quartz sheet approximates the parabolic shape, whereas the graphed relation $\sqrt{(\Delta R)} = F(\sigma)$ for different pressure cases are very nearly linear. The actual displacement range covered is $\sim$ 10–20 Å. A simple empirical theory of the experimental findings is then offered and the quadratic character of the graphed relationships interpreted on the assumption of elastic waves set up in each point of contact. B. F. K.

539.388.24

2165. On the stressed state of a circular iron sheet with strongly marked texture after deep-drawing. I. GRIGOROV, K. V. *J. Tech. Phys., USSR*, **18**, 175–86 (*Feb.*, 1948) *In Russian.*—The calculation is given of the azimuthal distribution of stresses in an iron disc

of sheet metal of a very marked structure after drawing into the form of a cylindrical iron vessel. The calculation is extended to include all slip systems, and also different types of texture. The azimuthal distribution of the cleavage stresses is strongly anisotropic and depends on the character of the texture. An explanation is offered for: Non-uniformity of the drawing ("festoons"); wrinkle and crease formation at the points of incomplete drawing; formation of transverse and longitudinal cracks; non-uniformity of thickness; and hardness along the periphery of the finished product. The results are in qualitative agreement with the observed behaviour of the material.

B. F. K.

539.389.1.08 : 621.317.41 : 620.172.224.2

2166. Investigation of the tensile test diagram and determination of the yield point by a magnetic method. DEKHTYAR, M. V. *J. Tech. Phys., USSR*, **17**, 1111–18 (*Oct.*, 1947) *In Russian.*—The tensile test diagrams of ferromagnetics are investigated for the simultaneous changes of the magnetic permeability. The method permits a determination of the stress at the commencement of yielding of individual grains (elastic limit) and of the yield point itself. The individual stages of the deformation process are distinguishable only when a distinct texture of the elementary magnetic moments (spins) is formed, as happens during the continuous commutation of a constant (external) magnetic field or when an alternating magn. field is applied during the tensile test. A.

539.4.01 : 666

2167. A kinetic approach to the theory of the strength of glass. COX, S. M. *J. Soc. Glass Technol.*, **32**, 127–46 (*T*) (*June*, 1948); Summary in *Nature, Lond.*, **162**, 947–9 (*Dec.* 18, 1948).—Criticizes the Griffith "flaw" theory and other explanations of the low strength of brittle materials, especially glass, and develops a "kinetic" theory on the assumption that the weakness is due to thermal fluctuations. Employing the Maxwell–Boltzmann expression and a simple atomic model, semi-empirical expressions are obtained representing various aspects of the strength behaviour for comparison with the experimental data.

G. O. J.

539.4.015 : 532.782

2168. Internal friction and precipitation from the solid solution of N in tantalum. KÊ, T.-S. *Phys. Rev.*, **74**, 914–16 (*Oct.* 15, 1948).—The internal friction or acoustic absorption peak (*v.* temperature) around 350°C previously observed in Ta [Abstr. 2964 (1948)] with a frequency of vibration $\simeq 1$ c/s was further analysed. It is shown that this peak has its origin in the stress-induced interstitial diffusion of N in Ta similar to the cases of C and O in Ta reported before. The precipitation of N from the solid solution with Ta was followed by internal friction measurements. A.

539.501

2169. Some new rheological phenomena and their significance for the constitution of materials. FREEMAN, S. M. AND WEISSENBERG, K. *Nature, Lond.*, **162**, 320–3 (*Aug.* 28, 1948).—From considerations of the general continuum theory the behaviour of isotropic materials which possess large elastic strain-recovery may be deduced. By relating the mechanical properties of these coarse-grained materials to the structural pattern, the possible structures of fine-grained materials suggest themselves by analogy when their mechanical properties are known. A series of experiments on coarse-grained (e.g. sponge assemblies) and fine-grained (e.g. colloidal solutions) materials are described which demonstrate the expected similarities and dissimilarities of behaviour. A. J.

539.501 : 532.13 : 541.

2170. Study of the rheological properties of rapid thickening colloidal systems by means of the Stormer viscometer. HIGGINS, H. G. AND PLOMLEY, K. Letter in *Nature, Lond.*, **163**, 22–3 (*Jan.* 1, 1949). For a commercial Stormer viscometer it is found that $\eta = KWt$ (η = viscosity, W = actuating weight, t = time for 100 revolutions, K = instrument constant). With $K = 2{\cdot}93 \times 10^{-4}$ this equation holds for the ranges: η, 2–75 p; W, 100–500 g, $t > 18$ s. For η between 1·5 cp and 2 p and W between 100 and 100 g an additional term must be added. Newtonian and non-Newtonian liquids were distinguished by plotting W against $1/t$. Such curves were plotted from observations at 25°c on casein—lime—sodium silicate, casein—caustic soda, urea formaldehyde resin—sulphuric acid—urea and resorcinol formaldehyde resin—formaldehyde, and the main conclusions are given. It is suggested that systems which exhibit instantaneous Newtonian flow whilst the viscosity is rapidly increasing may be regarded as a distinct type. [See Abstr. 1751 (1942), 836 (1948)]

H. G.

539.501 : 539.214

2171. The rheology of stiff pastes. WARD, A. G. AND FREEMAN, P. R. *J. Sci. Instrum. Phys. Ind.*, 2 387–96 (*Nov.*, 1948).—The general behaviour of stiff pastes is discussed in order to select the most suitable form of apparatus for rheological measurement. Two new instruments, each of the concentric cylinder type, which can be applied to different types of stiff paste, are described. The first relies on the use of a narrow annulus to enable absolute calculations to be made, and incorporates a novel method of filling using a split outer cylinder. It cannot be used satisfactorily with systems showing very rapid shear hardening, for which the second instrument was designed. This instrument enables the shear to be determined at all points across a wide annulus. Measurements show that, for some systems, Bingham's law of plastic flow is obeyed for each value of the shear, the effect of the shear hardening being to give an increasing value to the yield stress, as the amount of shear increases. Two new ideal rheological bodies are suggested and the effect of hydrostatic pressure on the flow properties of materials is discussed.

539.501 : 539.3

2172. An application of the theory of quasi-properties to the treatment of anomalous strain-stress relations. SCOTT BLAIR, G. W. AND CAFFYN, J. E. *Phil. Mag.*, **40**, 80–94 (*Jan.*, 1949).—A continuation of a previous paper [Abstr. 1019 (1947)]. The idea of quasi-properties is extended to cover anomalous strain-stress relations. The results of some experiments on relaxation of plastics at constant stress a

studied and for the less serious anomalies it appears that an equation integrated from the strain-stress fractional differential in some cases fits the data better than the strain-time equation. For extreme anomalies, an integrated form of the double fractional differential equation fits the data very well. When the aim is to relate the complex rheological behaviour of materials to the results of tests in which their firmness is assessed by handling, it is better to express the data in terms of quasi-properties rather than by classical methods. The conditions under which the Nutting equation and its fractional differential derivatives may be expressed in a simple dimensional form are discussed. L. S. G.

539.62 : 532.13 : 534.23

Internal friction in gases and liquids. *See Abstr.* 1761

539.8 : 531.66

High velocities produced at impact. *See Abstr.* 1707

539.893 : 548.0

2173. The linear compression of various single crystals to 30 000 kg/cm². Bridgman, P. W. *Proc. Amer. Acad. Arts Sci.*, **76**, 89–99 (*Oct.*, 1948).—The linear and volume compressions of large single crystals of 13 compounds and of Mg have been measured up to 30 000 kg/cm². The method of the lever piezometer was used. Comparison of the results for the different materials and for the various axes within a given material produces some interesting results, particularly that the volume decrements at 30 000 kg/cm² only vary by a factor of 2, while the anisotropy varies by a factor of 3. The deviations from linearity are also discussed. G. O. B.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM 541.121/.123

541.121/.123

2174. Graphical forecast of liquid-vapour and liquid-liquid equilibria of mixtures. Brodin, J. *C.R. Acad. Sci., Paris*, **227**, 1080–2 (*Nov.* 22, 1948) *In French.*—Mixtures of proportional fugacities, $f_2/f_1 = f'_2/f'_1, \ldots f_c/f_1 = f'_c/f'_1$, where $f_1, \ldots f_c$ are the fugacities of a mixture of $n_1, \ldots n_c$ moles of constituents $\beta_1, \ldots \beta_c$, and $f'_1 \ldots f'_c$ those of another, are called "isodynes." It is shown that two phases in true equilibrium are isodynes, and that from the isothermal isodynes, deduced from the equation of state, the representative points of phases in equilibrium can be found. S. W.

541.123.3

2175. The prediction of vapour-liquid equilibria for ternary mixtures from the data of binary systems. Li, Y.-M. and Coull, J. *J. Inst. Petrol.*, **34**, 692–704 (*Sept.*, 1948).—An approximate derivation of equations in vapour-liquid equilibrium relationships. Although the resulting equations are similar to those previously published, it is believed that they are in a more reasonable form from a theoretical point of view. The range of their validity is implied by the assumptions from which they are derived. Work is confined to binary and ternary systems; the same method can, however, be extended to quaternary systems or even more complex mixtures. The equations are tested with published experimental data, and the calculated results show good agreement with the observed values. A.

541.123.5

2176. Exchange between a copper plate containing radio-copper and a solution of copper ions. Quintin, M., Sue, P. and Bizouard, M. *C.R. Acad. Sci., Paris*, **226**, 1723–4 (*May* 24, 1948) *In French.*—The radio-Cu^{64} was prepared by the Cu(d, p) reaction in the cyclotron. After irradiation, the Cu was melted *in vacuo* to provide a metal of homogeneous specific activity. The surface was treated in various ways, viz., cold rolling followed by washing with different solvents such as alcohol, ether, benzene, water or nitric acid, or electrolytic polishing. In other cases the Cu was converted to sulphate and then deposited electrolytically on Pt. The Cu strips were then rotated in a solution of Cu sulphate at 20°. The preliminary results show the dominant role which the surface plays in the exchange phenomena. H. H. Ho.

REACTION KINETICS 541.124/.128

541.124/.127 : 539.163.4

2177. The effects of high energy radiations on water and aqueous systems. Krenz, F. H. *Can. J. Res. B*, **26**, 647–56 (*Sept.*, 1948).—Radiation chemistry is a study of the chemical effects produced by the high energy particles and quanta usually associated with nuclear reactions. When water absorbs this kind of radiation, it is decomposed into H and H_2O_2. The primary act of absorption is thought to result in the production of H atoms and OH radicals which then react to give the decomposition products. In dilute aqueous solutions the effects of radiation can generally be explained from the probable effects of H atoms and OH radicals on the solute. This is true when the solute consists of biologically active material. Since biological systems consist largely of water, the "indirect effect" that radiation has upon them through the medium of atoms and radicals produced in the water is very important. An attempt is being made to gain information about the "indirect effect" by investigating the properties of irradiated water. Evidence has been obtained for the production of long lived activity in irradiated water which may be attributed to vibrationally excited "polymers" of water. The extraordinary efficiency of the "indirect effect" of radiation is possibly related to properties of these excited polymers. A.

541.124 : 533.27

The kinetics of gaseous reactions. *See Abstr.* 1735

541.126

2178. Tribochemistry and the initiation of explosions. Bowden, F. P. and Yoffe, A. *Research, Lond.*, **1**,

581–8 (*Oct.*, 1948).—Experiments on nitroglycerin are described which indicate that explosions initiated by friction are caused by the development of "hot spots" (about 500°c) and that one cause of initiation by impact is the adiabatic compression of trapped air or vapour bubbles. T. S. E. T.

541.126 : 536.46

The influence of diffusion on flame propagation. *See Abstr.* 1870

541.128 : 538.22

Catalytic and depolarizing properties of manganese dioxide. *See Abstr.* 2004

ELECTROCHEMISTRY 541.13

541.133

2179. Influence of temperature-rise on the limiting conductivity of acetone. Eck, J. L. *C.R. Acad. Sci., Paris*, **226**, 1704–6 (*May* 24, 1948) *In French.*—The limiting conductivity of acetone, measured after current passage for several days, is often abruptly increased considerably by rise of temperature, and has the following characteristics: (1) It is manifest whatever be the portion of liquid heated, but it is particularly intense in the neighbourhood of electrodes. (2) The current intensity does not increase constantly with temperature, but augments very rapidly at first, passes through a maximum and then declines, even if the heating be continued. (3) The effect is greater with a freshly distilled specimen than with one which has been stored. (4) The relative increase depends essentially on the applied field, and is zero in a very weak field. The phenomena are explained by the assumption of molecular complexes which are polarized and oriented under the influence of the field, and which are susceptible to disintegration by rise of temperature; the probability of rupture is a maximum for a given field. H. H. HO.

541.133.1 : 539.155.2

Concentration of heavy thallium isotope by electrolytic migration. *See Abstr.* 2056

541.135 : 538.63

2180. Anodic behaviour of aluminium in a magnetic field. Antonoff, G. and Rowley, A. *Acta Phys. Austriaca*, **2** (*No.* 1) 101–3 (1948) *In English.*—Electrolysis of an Al salt solution using an Al anode and a Pt cathode was found to occur in the presence of a magnetic field of 2 000 gauss, although practically no current passed in the absence of a magnetic field. Deposition took place mostly in the circular region where the magnetic field was strong. D. S.

PHOTOCHEMISTRY 541.14

541.141.11

2181. On the oxidation of metals at low temperatures and the influence of light. Cabrera, N. *Phil. Mag.*, **40**, 175–88 (*Feb.*, 1949).—Mott's theory [Abstr. 1330 (1948)] is discussed and extended to oxides, such as Cu_2O, for which the metal diffuses through the oxide by the mechanism of vacant lattice points. It is also proved that the logarithmic law is valid down to very low temperatures and for pressures of O_2 above $\sim 10^{-4}$ mm Hg, independently of the temperature and the oxide considered. The model of Mott is applied to the explanation of the influence of light on the oxidation of Al. The theory agrees with experimental results and suggests that the influence will be observable only for frequencies such that $h\nu > 2$ eV; the limiting thickness of the oxide layer increases by a factor $(\psi + h\nu)/\psi$ under the influence of light. A.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18 : 532.13 : 539.501

Rheological properties of rapidly thickening colloids. *See Abstr.* 2170

541.18 : 535.43 : 537.531

X-ray small angle scatter of colloidal particles. *See Abstr.* 1932

541.18 : 539.26

Aqueous systems of surface-active substances and their X-ray diffraction characteristics. *See Abstr.* 2146

ADSORPTION 541.183

541.183 : 53.082

2182. On physical adsorption. II. A comparison of methods of estimating surface areas of crystalline solids by gas adsorption. Ross, S. *J. Amer. Chem. Soc.*, **70**, 3830–7 (*Nov.*, 1948).—Low temp. adsorption isotherms for C_2H_6 on NaCl and KCl crystals show a first-order phase transition and are described analytically. Correlation of values for specific surface of solid obtained by this and other methods has been made. W. R. A.

541.183 : 536.24

Numerical evaluation of mass transfer in packed solids. *See Abstr.* 1865

541.183.5 : 536.42

2183. Detection of changes of state in films adsorbed at the gas-solid interface. Gregg, S. J. and Maggs, F. A. P. *Trans. Faraday Soc.*, **44**, 123–36 (*March*, 1948).—Just as in bulk fluids phase transformation may be exhibited by means of curves of compressibility *v.* pressure, so in adsorbed films they are revealed by plotting the 2-dimensional compressibility β *v.* surface pressure. Examination of plots for a number of published isotherms show that: (*a*) true first order transformations are rare; (*b*) diffuse first order transformations are common; (*c*) third order transformations are sometimes found; (*d*) whilst a true or diffuse first order transformation between two phases in the monolayer (such as $L_1 \rightleftharpoons L_2$) gives rise to a maximum in the curve, multilayer formation is exhibited as a rising branch not followed by a falling branch. Transformations within the film are reflected in the shape of the isotherm. The significance of these results for the determination of the monolayer capacity of the adsorbent is discussed. A.

541.183.55

2184. The possibilities of linkage and of molecular orientation of a liquid upon a solid. Union [épitaxie] between kaolinite and water. KIEFER, C. *C.R. Acad. Sci., Paris*, **226**, 1602–3 (*May* 19, 1948) *In French.*—Variations of physico-chemical properties (apparent viscosity, stability, sediment volume, etc.) of argillaceous suspensions in the presence of electrolytes have indicated the possibilities of a union between kaolinite and water. It is shown that polar liquids may give rise to stable suspensions which are considerably stabilized when hydroxyl groups are present. Crystallographic conditions with respect to kaolinite and water are then examined and found to be suitable for a quasi-stable union between the two substances. H. H. HO.

ATOMIC THEORY 541.2

541.23 : 53.081.7

2185. Report of the committee on atomic weights of the American Chemical Society. LUNDELL, G. E. F. *J. Amer. Chem. Soc.*, **70**, 3531–4 (*Nov.*, 1948).—Recent atomic weight determinations for Be, Cu, Kr, Xe, N, Se, W, Si, and B are reviewed and no changes in the present international values are recommended although the recent chemical value for Be will require consideration by the International Committee since it is nearer to the mass spectral value. W. R. A.

CHEMICAL STRUCTURE 541.4/.6

541.5 : 539.132

Properties of strained hydrocarbons. *See Abstr.* 2038

541.57 : 536.66 : 536.62

Bond dissociation energies of Cd–CH_3 and CH_3–I. *See Abstr.* 1884

541.57 : 539.133

The electronic structure of simple molecules. *See Abstr.* 2042

541.64 : 532.13 : 621.317.39

Measurements of the mechanical properties of polymer solution by electromagnetic transducers. *See Abstr.* 1716

CHEMICAL APPARATUS 542.1/.7

542.2

2186. Automatic apparatus for continuous collection of liquid samples. BRIMLEY, R. C. AND SNOW, A. *J. Sci. Instrum. Phys. Ind.*, **26**, 71–3 (*March*, 1949).—The apparatus was designed in the course of work on chromatography to collect liquid as it dripped slowly from an absorbent column and divide it automatically into consecutive portions of suitable volume. It deals with 60–70 samples of ¼ litre each. A.

CHEMICAL ANALYSIS 543/545

543.545

2187. Determination of the purity of the grey uranium oxide (U_3O_8) by means of its radioactivity. MERCADER, A. L. *Publ. Fac. Cienc. Fis.-Mat. La Plata* (*No.* 195) 161–9 (1948) *In Spanish.*

543.545 : 539.133 : 535.343–15

Microwave spectroscopy. *See Abstr.* 1816

545.8 : 539.16.08

2188. Radioactive determination of potassium in solids. GAUDIN, A. M. AND PANNELL, J. H. *Analyt. Chem.*, **20**, 1154–6 (*Dec.*, 1948).—A method for the determination of K by use of a Geiger counter has been extended and modified. The procedure obviates errors due to self-absorption and is applicable to concentrations of K > 1%. A.

545.82

2189. The spectro-chemical analysis of the bearing alloys. GHOSH, M. K. AND MAZUMDER, K. C. *Indian J. Phys.*, **22**, 409–12 (*Sept.*, 1948).—The technique of spectro-chemical analysis of bearing alloys with copper base has been developed by means of a Hilger medium quartz spectrograph. The ranges of the different elements determined are: Sn, 6·50 to 7·90%; Pb, 3·0 to 3·65%; Ni, 0·70 to 1·0%. The determinations agree well with those found chemically. A.

545.82 : 535.33.03 : 621.396.612.7

2190. Electric spark generator for spectrochemical analysis with aperiodically damped charging current circuit. BARDÓCZ, A. *Publ. Univ. Tech. Sci., Budapest* (*No.* 1) 2–33 (1948) *In English.*—The circuits in question, which are mains-driven through step-up transformers, are oscillatory circuits, across which are connected the spark-gap electrodes and a synchronous rotary switch. Conventional analysis shows that low-decrement circuits cause long-sustained oscillations of excessive amplitude subjecting the transformer to h.v. stresses and causing irregularity in spark repetition and arcing at the switch. Damping sufficient to effect aperiodic discharge eliminates these weaknesses, leads to operation less sensitive to capacitance change and reduces mains current consumption. With such operation the required values of damping resistance, the phase shift and the steady voltage across the capacitor are shown as curves against capacitance value. Voltage and current oscillograms show the contrasting results of aperiodic and periodic working, confirming the analysis. Operation with a multiple-contact switch is similarly shown. H. G. M. S.

545.82 : 535.243

New "offset" method of interpreting spectrophotometric curves. *See Abstr.* 1786

545.84

2191. Mechanism of chromatogram formation. GAPON, E. N. AND GAPON, T. B. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 5) 817–20 (1948) *In Russian.*—From available experimental data it is possible to classify the kinds of processes leading to the formation of chromatograms as follows: (*a*) molecular adsorption of non-electrolytes and electrolytes (molecular chromatogram); (*b*) exchange of ions between adsorbent and solution (ion-exchange chromatogram);

(*c*) formation of slightly soluble compounds (precipitated chromatogram). It is obvious that this classification will prove insufficient, but prior to its amplification many factual details will have to be elucidated. Molecular chromatograms are typical not only for dissolved mixtures of substances, but for vapour mixtures as well. Experimental results and interpretations so far presented are discussed by the author, whose own object was the investigation of the mechanism of the ion-exchange chromatograms under conditions of adsorption equilibrium in an infinitely small absorption column element. That means that the time spent by the solution in the pores of such a column element is < time of establishment of equilibrium in that layer. Furthermore, the propagation of the chromatographic ion dissociation was studied on Cu^{++}–Co^{++} vapour. On the following substances chromatograms were formed: permutite, bentonite clays, barium aluminate, ZnO of special preparation, specially prepared aluminium oxide. Bad dissociation was observed on kaolin clays, glauconite, Hammersten casein and soils. As a standard vapour Co^{++}–Ni^{++} was used, which did not dissociate on permutite, barium aluminate, aluminium oxide; the author succeeded in preparing a kind of permutite, on which Co^{++}–Ni^{++} did dissociate. The following general conclusions were drawn: On any adsorbent suitable for ion exchange the formation of ion-exchange chromatograms is possible if (1) selective ion adsorption leading to the complete removal from the solution of the adsorbed ion takes place, and/or (2) there is a different adsorptivity of the chromatographic ions. The latter is determined (*a*) by the structure of the adsorbent or (*b*) by the interaction forces between adsorbed ions and lattice ions of the adsorbent, quantitatively determined by the exchange constant K of the equation of the exchange adsorption isothermal. Four methods of obtaining, and classes of, ion-exchange chromatograms are: (1) filtration chromatogram, (2) diffusion chromatogram, (3) heterogeneous, and (4) liquid chromatogram. B. F. K.

CRYSTALLOGRAPHY 548

548.0 : 531.743.2

2192. A new theodolite goniometer. Ramakrishna Rao, I. and Satyavanta Rao, S. V. *J. Sci. Industr. Res.*, **6**, 485–7 (*Dec.*, 1947).—The general features, adjustment and method of use, of a universal type of goniometer for measurement of the angles between crystal surfaces is described. The instrument consists of a 6 in diameter horizontal and 5 in diameter vertical scale, both divided in half degrees, together with verniers and magnifiers enabling readings to one minute; a crystal-holder attached to the centre of the horizontal scale; a collimator with illuminating arrangement; and a horizontal telescope, with total reflection prism, for observing the reflected beam of light from the crystal surface. The telescope has a combination objective so that it can also be used as a low power microscope. A photograph of the assembled instrument is given. S. W.

548.0 : 537 : 537.312.5

The photoconductivity of cadmium-sulphide crystals. *See Abstr.* 1907

548.0 : 539.133 : 535.375.5

Raman spectra of barytes. *See Abstr.* 1833

548.0 : 539.37

Equation of motion of crystal dislocations. *See Abstr.* 2157

548.0 : 539.893

Compression of single crystals to 30 000 kg/cm². *See Abstr.* 2173

548.24 : 548.7

2193. Some considerations on the twinning of calcite. Lifshits, I. M. and Obreymov, I. V. *Izv. Akad. Nauk, SSSR (Fys. Ser.)* **12** (*No.* 2) 65–80 (1948) *In Russian.*—Investigation of twinning on the model of a translational space lattice giving a more illustrative analysis of the early stages and allowing qualitative evaluation. The Green function is developed for a triclinal lattice and the 2- and 3-dimensional cases investigated. Appendices analyse the case of a hemispace bounded by a plane and develop the Green function for an infinite space lattice in the general case. L. J. G.

548.33 : 536.424 : 548.73

2194. Study of the modifications of manganese dioxide. McMurdie, H. F. and Golovato, E. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 589–600 (*Dec.*, 1948).—Past work on the modifications of MnO_2 of interest in dry-cell manufacture is reviewed. New X-ray data, at both room and elevated temperatures, combined with differential heating curves lead to the conclusion that 5 types of MnO_2 exist: (1) well-crystallized pyrolusite; (2) gamma MnO_2, a poorly crystallized pyrolusite; (3) ramsdellite; (4) cryptomelane, a form containing essential K or Na; and (5) delta MnO_2, believed to be a poorly crystallized cryptomelane. The high-temperature X-ray diffraction data indicated the phase changes that cause the heating-curve effects. A new crystal form of manganosic oxide (Mn_3O_4), stable above 1 170°C, was found to be cubic of spinel structure. Fineness determinations by both the N adsorption and the X-ray line broadening methods were made on selected samples. A.

548.33 : 548.737 : 536.42

2195. Polymorphism of beryllium oxyacetate. Watanabé, T. and Saito, T.; Seki, S., Momotani, M. and Chihara, H. *Nature, Lond.*, **163**, 225–7 (*Feb.* 5, 1949).—[I] Cubic beryllium oxyacetate assumes the appearance of soft wax at ~ 160°C, then melts sharply at 285°. The former is about the melting point to be expected from the homologous series to which it belongs. Most of the X-ray lines of the waxy phase are accounted for by a rhombohedral cell with $a = 9{\cdot}72kX$, $\alpha = 54° 20'$, $Z = 1$, but the true symmetry is lower. An unstable form prepared by sublimation is monoclinic with $a = 13{\cdot}75$, $b = 9{\cdot}24$,

$= 16{\cdot}21kX$, $\alpha[\beta?] = 98° 55'$, $Z = 4$, space group Pm, $P2$ or $P2/m$. [II] Differential thermal analysis gives 148° for the transition temperature, 286·7° for the melting point. The transition shows hysteresis if the sample is heated above ~210°c. Dilatometric measurement shows discontinuities in the expansion coefficient at 32°, 42°, 77° and 124°. At 148° the volume increases by ~5·7% of the volume at 25°. The vapour pressure equation is $\log P = -6\,934{\cdot}8/T + 15{\cdot}0299$ below 148° and $\log P = -5\,922{\cdot}8/T + 12{\cdot}6266$ above, giving heats of sublimation of 31·7 and 27·1 kcal/mole respectively. The heat of transition is thus 4·6 kcal/mole; the entropy of transition 11·0, and the entropy of melting 11·6.

A. J. C. W.

548.5

2196. Some crystal-boundary phenomena in metals. Chalmers, B. *Proc. Roy. Soc. A*, **196**, 64–73 (*Feb.* 22, 1949).—Techniques are described for preparing specimens of Sn and Pb consisting of 2 or 3 crystals with controlled orientations. The direction of formation of the boundary between 2 crystals is shown to be dependent on the relative orientations of the crystal axes, and to be a result of a variation of the solid-liquid equilibrium temp. with the crystallographic characteristics of the solid surface in contact with the liquid. A qualitative explanation is advanced in terms of a theory of melting and freezing which envisages the simultaneous operation of "melting" and "freezing" processes which are equal at the equilibrium temp. New observations of the "macro-mosaic" effect are recorded, and it is shown that crystal boundaries can move at temps. near the m.p. in the absence of plastic strain, if reduction of the boundary area is produced. It is also demonstrated that the specific free energies of all boundaries, except twin boundaries, in Sn are equal, and do not depend on the relative orientations of the crystals. A.

548.55

2197. Single crystal growth of scheelite. Zerfoss, S., Johnson, L. R. and Imber, O. Letter in *Phys. Rev.*, **75**, 320 (*Jan.* 15, 1949).—Scheelite crystals were grown by flame fusion and from the melt by the gradient technique. Clear 4×4×4 mm crystals were obtained with the flame fusion method. Better specimens were produced by the gradual lowering of molten salt in a Pt crucible through a Pt resistance furnace, in which a temp. gradient of 59°c/cm was maintained. Single 5×5×5 mm crystals were obtained. J. A. F.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

2198. The free path for the transfer of energy in crystals. Born, M. *Proc. Math. Phys. Soc. Egypt*, **3**, 35–41 (*May*, 1946) *In English.*—Present approximations to a quantum-mechanical theory of crystals break down when the linear dimensions are $\sim 2/\beta\theta$ times the cell edge, where β is the thermal expansion coefficient and θ is the Debye temperature. It is not clear whether this factor, varying over the range ~100 to ~1 000, is a limitation on the theory or on the size of perfect crystals. The latter is more probable, as a factor of this order of magnitude is required to explain the observed values of thermal conductivity, melting point and yield stress. A. J. C. W.

548.7 : 531.19

2199. On statistical mechanics of order-disorder transformations. Hartmann, H. *Z. Naturforsch.*, **3a**, 617–21 (*Aug.–Nov.*, 1948) *In German.*—The author considers partition function and specific heat for a one-dimensional mixed crystal with interaction between nearest neighbours only. This can be computed exactly and leads to a result which behaves qualitatively unlike the three-dimensional case.

H. MO.

548.7 : 539.11

2200. A theoretical investigation into some properties of ionic crystals. Löwdin, P.-O. *Univ. Uppsala, Diss.* (*Almqvist & Wiksells Boktryckeri AB, Uppsala*) 126 *pp.* (1948) *In English.*—The cohesive energy of a system of ions having complete electron shells is investigated by a quantum mechanical method. The one-electron wave functions and their expansions in spherical harmonics are derived and formula are set up for the electrostatic, exchange, and *S*-energy. The numerical methods used are described in detail. Application is made to some crystals of the NaCl type. The quantities calculated are the cohesive energy, the interionic distance, the elastic constants and the compressions at high pressure. A necessary preliminary to these calculations is the study of the ions F^-, Cl^-, Li^+, Na^+ and K^+. The compression of alkali halides at high pressures and the transitions between different types of lattices are discussed. L. S. G.

548.7 : 539.11

2201. The surface energies of inert-gas and ionic crystals. Shuttleworth, R. *Proc. Phys. Soc., Lond. A*, **62**, 167–79 (*March* 1, 1949).—It is shown that the surface energies of inert-gas crystals are $\propto$ their sublimation energies. The constant of proportionality is evaluated for the {111}, {100} and {110} faces for different assumed forms of the interatomic repulsive forces; to within 15% it is independent of the face, and of the form of the repulsive force. The distance of the outermost plane of atoms from the next at a {100} face is 2·54% greater than normal; this distortion makes a negative contribution of 1% to the surface energy. The surface energies of Na and K halide crystals are calculated; the ratio of the energies of {110} and {100} faces ~2·5. The contribution of van der Waals type forces to the surface energy of a {100} face is almost half the total. Elementary methods are given for the evaluation of lattice sums. A.

548.7 : 539.11

2202. On the surface free energy of certain metals. Huang, K. and Wyllie, G. *Proc. Phys. Soc., Lond. A*, **62**, 180–91 (*March* 1, 1949).—A simple and yet adequate model is proposed to calculate the surface energy and surface double layer for a number of monovalent metals. In this the valence electrons are treated according to a simple Sommerfeld model, and the positive charge of the ions is distributed uniformly through the metal. By a suitable combina-

tion of the methods of Thomas–Fermi and of direct wave mechanics, both the surface energy and the strength of the double layer can be calculated. The surface double layers for the metals considered are found to lie in the range 0·1–0·5 eV. The contribution to the surface energy from the electrostatic energy in the double layer is found to be very small. In estimating the surface energy, the electrons in a metal can be considered as moving in a box with finite potential walls of suitably determined height ϕ. A temperature-dependent term in the surface free energy due to the change in lattice vibrations caused by the free surface is also considered. The surface energies obtained from ϕ determined in two independent ways agree closely and are found to agree with the experimental values of the surface tension of the liquid metals to within a factor of 1·5. A.

548.7

2203. Cation arrangement in spinels. VERWEY, E. J. W., DE BOER, F. AND VAN SANTEN, J. H. *J. Chem. Phys.*, **16**, 1091–2 (*Dec.*, 1948).

548.7 : 669

2204. The Brillouin zones for the CO_2Al_9 and $NiAl_3$ structures. RAYNOR, G. V. AND WALDRON, M. B. *Phil. Mag.*, **40**, 198–205 (*Feb.*, 1949).—It is demonstrated that the most probable Brillouin zones are characterized by inscribed spheres which can contain 2·12 and 2·00 electrons per atom respectively for CO_2Al_9 and $NiAl_3$. This result, combined with that of Douglas [Abstr. 2214 (1949)] confirms that in Al-rich alloys, transitional metal atoms absorb electrons from the structure as a whole. It is also concluded that the number of electrons absorbed per atom of a transitional metal cannot differ appreciably from the number of vacancies per atom in its atomic orbitals. The results of the paper support the view that the intermetallic binary and ternary compounds, formed by Al and transitional metals of the first long period, are properly to be considered as electron compounds rather than as compounds controlled mainly by electrochemical or atomic size considerations. A.

548.7 : 669.018

2205. A note on binary alloys. MAZUMDER, K. C. *Indian J. Phys.*, **22**, 397–400 (*Sept.*, 1948).—The binary alloys of some metals like Cu, Ag and Au can be expressed by approximately definite chemical formula and are known as abnormal valency intermetallic compounds. The different phases of these alloy systems have definite electron-atom ratios which are generally expressed as 1.4, 3/2, 21/13 and 7/4 for α, β, γ and ε phases respectively. They can, however, be expressed more uniformly as 21/15, 21/14, 21/13 and 21/12. This regularity suggests the possibility of this being extended inside the α-phase also. The α-phase may, then, be composed of several minor phases of electron-atom ratios, 21/16, 21/17, 21/18, 21/19, 21/20, at the boundaries of which there will be discontinuities, however small, of some physical properties of the alloys. The indications of such discontinuities found in the published data are discussed. A.

548.73 : 537.531 : 621.385.15.08

2206. The application of electron multiplier tubes in the measurement of X-ray beam intensities and in the determination of crystal structure. PAPP, G. AND SASVÁRI, K. Letter in *J. Appl. Phys.*, **19**, 1182 (*Dec.*, 1948).—Summary of a previous paper [Abstr. 2255 (1948)]. A. J. C.

548.73 : 532.7

Expansion of solid solutions in aluminium. *Abstr.* 1731

548.7

2207. Crystal setting by X-rays. JEFFERY, J. *J. Sci. Instrum. Phys. Ind.*, **26**, 42–3 (*Feb.*, 1949). The practical steps are outlined of an X-ray setti method which can be used to calculate the goniome arc adjustments for a crystal which fails to give recognizable zero layer curve when mis-set. T method utilizes the white radiation streak associat with a characteristic reflection. No special relatio ship of the arcs to the X-ray beam is assumed and t bottom arc can be off zero. For fairly large angles mis-setting the corrections are accurate to 0·05°.

548.73

2208. The ambiguity factor in implication theo BUERGER, M. J. *Acta Cryst.*, **1**, 259–63 (*No* 1948) *In English.*—The implication diagram may derived alternatively from

$$I(x, y) = \Sigma_{h'}\Sigma_{k'} Q_{h'k'} \cos 2\pi(h'x + k'y)$$

where h' and k' depend on h and k and $Q_{h'k'}$ depen on the F_{hkl} in a way (expressed in tables) chara teristic of the symmetry axis of the crystal. Grou theory and Fourier-synthesis discussions of a biguities are given; it is shown that the net ambigui is equal to M/q, where M, the "basic ambiguity," the number of times the implication cell is contain in the crystal cell, and q is the fraction of the diffracti maxima not extinguished by the space group f the projection considered. The ambiguities ca ordinarily, be resolved by M/q Patterson line sy theses. The possibility of an approach to pha determination, other than the Harker–Kasp inequalities, is foreshadowed. [See also Abstr. 6 (1947)]. A. J. C.

548.73

2209. X-ray analysis and the method of steepe descents. COCHRAN, W. *Acta Cryst.*, **1**, 273 (*No* 1948) *In English.*—Considers the problem of co rectly orienting and positioning a molecule of know structure in a unit cell and concludes that, if t structure as a whole is too complex for its Patterso diagram to be interpreted, the method of steepe descents cannot be expected to yield a solution. J.

548.73

2210. Method of steepest descents in X-ray analysi VAND, V. Letter in *Nature, Lond.*, **163**, 129– (*Jan.* 22, 1949).—Previous results [Abstr. 640 (194 2998 (1947), 2258 (1948)] are improved by allowi greater weight to low-order reflections. A. J. C.

548.73

2211. Radial Patterson distribution functio BOOTH, A. D. AND WRINCH, D. Letter in *Natu Lond.*, **163**, 169 (*Jan.* 29, 1949).—By comparison calculated and observed radial Patterson distributio functions proposed molecular models of, e.g., protei can be tested for consistency with the X-ray diffracti pattern, without knowledge of the inter-molecul arrangement. [Abstr. 3363 (1947), 3532 (1948)].

A. J. C.

548.735.4 : 518.5

2212. A mechanical calculating machine for X-ray structure factors. VAND, V. Letter in *Nature, Lond.*, **163**, 169–70 (*Jan.* 29, 1949).—The expression $f_i \cos 2\pi(hx_i + ky_i + lz_i)$ is summed for a series of values of l by a machine of the tide-predictor type. The phases $hx_i + ky_i$ are set on harmonic units, z_i on multiplier bars, which at each stroke add z_i to the harmonic units. The angles are transferred to cosine arms of length f_i, the sum being given by a pulley belt differential operating two output dials. If desired the output for successive values of l can be recorded automatically on a graph, with the sign of the sum indicated. The machine can also be used for Fourier synthesis and for calculating corrections by the method of steepest descents. A. J. C. W.

548.736.33

2213. The structure of $TiCl_2$. BAENZIGER, N. C. AND RUNDLE, R. E. *Acta Cryst.*, **1**, 274 (*Nov.*, 1948) *In English.*—$TiCl_2$ prepared by the reduction of $TiCl_4$ with H in a heated quartz tube, is found from X-ray powder photographs to have the CdI_2 structure with $a = 3{\cdot}561 \pm 0{\cdot}005$ Å and $c = 5{\cdot}875 \pm 0{\cdot}008$ Å. The fact that the data of Klemm and Grimm [*Z. anorg. Chem.*, **249**, 198 (1942)] do not agree with this may be evidence for another crystal form. J. T.

548.736.33 : 539.163.4

The first isolation of element 93. *See Abstr.* 2081

548.736.37 : 669

2214. Structure of Co_2Al_3. DOUGLAS, A. M. B.; RAYNOR, G. V. AND WALDRON, M. B. Letter in *Nature, Lond.*, **162**, 565–6 (*Oct.* 9, 1948).

548.736.4

2215. The crystal structure of the normal orthophosphates of barium and strontium. ZACHARIASEN, W. H. *Acta Cryst.*, **1**, 263–4 (*Nov.*, 1948) *In English.*

548.736.5 : 537.226

2216. Crystalline structure of the hexagonal and the rhombic barium platinate-titanate. BLATTNER, H., GRÄNICHER, H., KÄNZIG, W. AND MERZ, W. *Helv. Phys. Acta*, **21** (*No.* 5) 341–54 (1948) *In German.*—Hexagonal crystals having the composition $Ba(Ti_{0{\cdot}75}Pt_{0{\cdot}25})O_3$ and rhombic crystals ($Ba_4Ti_2PtO_{10}$) are obtained under similar conditions as monocrystals of the pseudo-cubic, ferroelectric $BaTiO_3$. Both the former crystalline structures have been determined by X-ray method and compared with $BaTiO_3$. Although the structures investigated contain even larger TiO_6 octahedra than the ferroelectric $BaTiO_3$, their crystals show no anomalous dielectric behaviour, as the Ti^{4+} ions have been forced into stable positions. F. L.

548.737

2217. X-ray studies of crystalline proteins. PERUTZ, M. F. *Research, Lond.*, **2**, 52–61 (*Feb.*, 1949).—A brief review of some properties of proteins and theories of their constitution, followed by a fuller account of electron microscope [Abstr. 3022 (1948)] and X-ray [Abstr. 3372 (1947), 3018 (1948) etc.] work on their structure. 32 references. A. J. C. W.

GEOPHYSICS 55

550.3 : 529.786 : 526.71/.72

Pendulums and attraction of sun and moon. *See Abstr.* 1670

550.34 : 534.2

2218. Recording of longitudinal waves of short period. CIALDEA, R. *Ann. Geofis.*, **1**, 207–13 (*April*, 1948) *In Italian.*—The theory of the operation of a long wave recording instrument based on condensation is given; the author then introduces a modification of the apparatus suggested by Benioff in the particular case of seismic waves, in order to improve its response. A.

550.361

2219. The effect of uplift and denudation on underground temperatures. BENFIELD, A. E. *J. Appl. Phys.*, **20**, 66–78 (*Jan.*, 1949).—Gives calculations and computations, based on simple ideal conditions, of the possible disturbances of underground temperatures caused by uplift and denudation. The effects of the speed of denudation, the rate of uplift, and the time during which these two processes may have been operating, are illustrated by numerical tables applying to some specific ideal situations. A.

550.372 : 621.317.331

2220. Method of investigating the establishment of an electric field in the earth. ENENSTEIN, B. S. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 2) 239–42 (1948) *In Russian.*—The experimental arrangement consists of a conductor both of whose ends are connected to earth, and in which rectangular pulses are set up by a thyratron-controlled short-wave transmitter. The signals are received by a similar dipole arrangement connected to a receiver circuit thyratron coupled to a c.r.o. The time for establishing the electric field in the earth depends on the specific resistance of the earth and the distance between transmitting and receiving dipole, respectively. A simple relation, viz. $\tau = 0{\cdot}314\chi^2/\zeta$, is found to apply in the case of homogenous and isotropic earth, where τ is time of establishment of the field in sec, χ distance between the respective dipole centres, and ζ specific resistance of the earth in Ω-m. B. F. K.

550.38

2221. On the interpretation of the coefficients of second order in the series development of geomagnetic potential. MACHT, H. G. *Naturwiss.*, **35** (*No.* 4) 121–2 (1948) *In German.*—It is proposed to develop the geomagnetic potential with respect to geomagnetic rather than geographic co-ordinates (z parallel to the magnetic axis of the earth x, y, perpendicular) and to interpret second order terms of the series as global anomalies, which, together with the homogeneous magnetization, should be subtracted before tectonic anomalies are considered. H. MO.

550.38

2222. Remark concerning the interpretation of higher terms of geomagnetic potential. BARTELS, J. *Naturwiss.*, **34** (*No.* 4) 122 (1948) *In German.*—It is pointed out that the interpretation of the terms of higher order in the series development of the geomagnetic potential by Macht [Abstr. 2221 (1949)] is somewhat arbitrary and that many other physical assumptions are equally valid. H. MO.

550.38

2223. Reply to the foregoing remark of J. Bartels. MACHT, H. G. *Naturwiss.*, **34** (*No.* 4) 122 (1948) *In German.*—Previous remarks of the author [Abstr. 2221 (1949)] are slightly amplified. H. MO.

550.38 : 523.73

2224. Persistent solar rotation-period of 26⅞ days and solar-diurnal variation in terrestrial magnetism. OLSEN, J. *Terr. Magn. Atmos. Elect.*, **53**, 123–34 (*June*, 1948).—Daily records of H at Godhavn exhibit a 26⅞ day recurrence-tendency, the average value in the first half of the period being rather low and in the second half, rather high. The effect is most pronounced for the four summer months, the amplitude then being 40 γ, and is due to the disturbance daily variation (S_D), the amplitude of this latter on the 11th day being $\sim 4\times$ that for the 20th day of the cycle. The fixed period has persisted for 15 years, pointing to an origin in a solar layer with fixed rotation-period. The phenomenon appears restricted to latitudes higher than the auroral zone. D. R. B.

550.38 : 538.71 : 538.082.102

2225. Rock magnetism as a clue to earth's magnetic history. TORRESON, O. W., MURPHY, T. AND GRAHAM, J. W. Letter in *Phys. Rev.*, **75**, 208–9 (*Jan.* 1, 1949).—A preliminary report of the work undertaken to measure the magnetization of rocks in several sites in the Western United States. Assuming that fine-grained, undisturbed sedimentary rocks laid down several million years ago in calm water still retain the magnetization acquired as a result of the orientation of the magnetic particles in the direction of the earth's field, the measurement of 94 samples show that there is a definite tendency for the horizontal component of the rock magnetization to centre on the geographic rather than the present magnetic axis. This was to be expected if the magnetic north has oscillated 30° to 40° to either side of a mean geographic north. The inclination of the magnetization is slightly less than the present inclination of the earth's field, which seems to have remained approximately centred on the geographic axis for the past 100 million years. They do not support the possibility that the earth's field has at one time reversed its direction. V. C. A. F.

550.38 : 538.7 : 523.755

Correlation of coronal and geomagnetic observations 1944–6. *See Abstr.* 1653

550.38 : 551.510.535 : 551.59

Differential penetration and magnetic storms. *See Abstr.* 2250

550.381

2226. On the origin of the terrestrial magnetic field and on magnetic storms. MEDI, E. *Ann. Geofis.*, **1**, 509–12 (*Oct.*, 1948) *In Italian.*—A continuation of former work, the paper outlines a theory of planetary magnetism. Some new hypotheses are given to explain the fact that the magnetic field is maintained whilst the rotating "corona" of electrons to which it is due is permanently weakened by diffusion of electrons into space. The magnetic field of the sun is considered in its interaction with the electron corona, resulting in variations of the kinetic energy of the electrons, and thus in variations of the primary magnetic field of the planet. The author likens this interaction to a cosmic betatron and suggests that variations of the sun's field may produce magnetic storms. B. F. K.

550.387

2227. Solar magnetic field and telluric currents. MEDI, E. *Ann. Geofis.*, **1**, 568–9 (*Oct.*, 1948) *In Italian.*—Assuming the validity of the new theory of the origin of the terrestrial magnetic field [Abstr. 2226 (1949)] a tentative explanation of the existence of telluric currents and of the diurnal variation of the terrestrial magnetic field is presented. B. F. K.

550.837.3

2228. Interpretation of data from electrical resistivity geophysical surveys. COOPER, W. G. G. AND HOUGH, J. M. Letter in *Nature, Lond.*, **162**, 970 (*Dec.* 18, 1948).—Correspondence arising out of earlier communications [Abstr. 3028 (1948)]. J. M. H.

ATMOSPHERE . METEOROLOGY 551.5

551.508 : 533.6.08 : 621.317.39 : 621.317.733

2229. A portable thermistor bridge for micro-meteorology among growing crops. PENMAN, H. L. AND LONG, I. *J. Sci. Instrum. Phys. Ind.*, **26**, 77–83 (*March*, 1949).—Using thermistors, a portable unit has been built to measure temperature, humidity and wind speed among growing potato crops in connection with an investigation into factors affecting the spread of virus disease. Type F thermistors are used as resistance thermometers for measuring dry- and wet-bulb temperatures: Type L, with the glass sheath removed, are used to measure wind speed on the hot-wire anemometer principle. For the latter, the response has been found to depend upon ambient air temperature, but by including another thermistor in the bridge circuit complete compensation has been achieved over a temperature range from 13° to 30°C. A.

551.51 : 550.4

2230. Convection patterns in the atmosphere and ocean. MONTGOMERY, R. B., *et. al. Ann. N.Y. Acad. Sci.*, **48**, 705–844 (*Sept.* 15, 1947).—A symposium of 11 papers.

551.510.4

2231. On the oxygen content of the atmosphere. HARTECK, P. AND JENSEN, J. H. D. *Z. Naturforsch.*, **3a**, 591–5 (*Aug.–Nov.*, 1948) *In German.*—The question of the origin of atmospheric O is discussed. It is concluded that the O produced by photo-dissociation of atmospheric water vapour could have replenished the atmospheric O 50 times during the

lifetime of the earth. By careful analysis of diffusion, and by arguments based on known facts of reaction kinetics of the H_2O recombination, upper and lower limits for this oxygen production are estimated. H. MO.

551.510.4 : 523.77

2232. Comparison of atmospheric methane content above Flagstaff, Arizona, and Columbus, Ohio. ADEL, A Letter in *Phys. Rev.*, **75**, 322 (*Jan.* 15, 1949).—Comparison of a continuous high resolution map of the infrared solar spectrum above Flagstaff with an independently ascertained spectrum above Columbus reveals a widespread and uniform distribution of CH_4 above the earth. W. R. A.

551.510.4 : 539.155.2 : 523.77 : 535.334

2233. Isotopes of carbon and oxygen in the earth's atmosphere. GOLDBERG, L., MOHLER, O. C. AND MCMATH, R. R. Letter in *Phys. Rev.*, **74**, 1881–2 (*Dec.* 15, 1948).—Inspection of the solar map in the 2 μ region reveals the presence of several relatively faint band structures for some of which the spacings are $\sim\frac{1}{2}$ those of the main CO_2 bands. The consequences of isotopic substitution for C and/or O are reviewed and the faint band structures on analysis are interpreted in part as arising from isotopic analogues of CO_2. W. R. A.

551.510.5 : 551.593.55

2234. Structure of the high atmospheric layers from twilight observations. MEGRELISHVILI, T. G. AND KHVOSTIKOV, I. A. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 7) 1283–6 (1948) *In Russian.*—Regular electrophotometry of twilight has been carried out since 1942 at the Abastuman astrophysical observatory. The accuracy of the method (cf. Megrelishvili, *ibid.*, **53**, 127 (1946)] was high ($\pm 1\%$) in all conditions of light. As a result, 250 twilight curves comprising different years and seasons, at dawn and dusk conditions, have been compiled which the authors think might represent complete materials for studying the structure of the high atmospheric layers by the twilight method. The paper is devoted to comparing the resulting values of density and pressure with corresponding values obtained by other workers. The values on which this comparison is based are those of the "general" curve (i.e. the average of 250 individual curves) which is free of background influences of the night sky and expressed in absolute units. The calculations of the pressure at various altitudes were made by Staude's method. For altitudes of 40–120 km the calculated density values were compared with Whipple's observations on meteors, the pressure values with Harang's polar light observations and, finally, with density determinations by radio-wave observations (for *D*-layer, those of Budden, Ratcliffe and Wilkes; for *E*- and *F*-layers, Appleton's measurements). Thus, for any altitude, there were always values obtained on 3 entirely independent methods for comparison. It is interesting to find that between 40 and 180 km the twilight curve not only agrees with all the other curves, but that an average curve from all the available curves exactly coincides with the twilight curve, and with this curve only. The agreement does not continue beyond 180 km, but there are other theoretical results available now which again would seem to bring out the reliability of the twilight curve even at higher altitudes. The influence of 2nd-order diffraction was neglected throughout, but it is proposed to give a theory considering this effect before long. B. F. K.

551.510.5 : 621.396.11

2235. Pulse reflections from the tropopause and ozone layers (10 to 30 km). GHERZI, E. *Bull. Amer. Met. Soc.*, **29**, 136–8 (*March*, 1948).—Brief account of tropospheric reflections of radio signals observed over a period of 6 months at Shanghai with radar equipment (frequency 18–23 Mc/s, peak power 100 kW). Signals of variable amplitude are observed from 3 distinct ranges (10–13 km, 15 km and 25–30 km). It is suggested that these represent reflections from ozone layers in the atmosphere. W. J. G. B.

551.510.535

2236. The geomagnetic nature of the *F*2-layer longitude-effect. BAILEY, D. K. *Terr. Magn. Atmos. Elect.*, **53**, 35–9 (*March*, 1948).—The main conclusions deduced from a study of region F_2 critical frequency data from Japanese and other stations are: (*a*) The "longitude effect" in critical frequencies extends to quite high latitudes. (*b*) A trough of low values of $f_{F_2}^{\circ}$ exists near the magnetic equator at noon at all seasons. (*c*) Near the minimum of this trough, region F_2 appears to be very thick and is sometimes subdivided into 2 or more layers. W. J. G. B.

551.510.535

2237. A sporadic *F*-layer. BURKARD, O. *Terr. Magn. Atmos. Elect.*, **53**, 63–5 (*March*, 1948).—A study of normal incidence ionospheric records obtained at latitude 69·6°N during the night in the period October 1944 to March 1945 shows that sudden and irregular bursts of ionization sometimes occur at the level of region F_2'. This "sporadic *F*-layer" seems to occur most frequently between the hours 0300 and 0500 and the average value of its critical frequency is about 3 Mc/s. Possible causes of the ionization are briefly mentioned but the data is considered insufficient to permit any definite conclusions. W. J. G. B.

551.510.535 : 537.568

2238. The question of the structure of the atmosphere and of the processes in the region of the *F*-layer. ALPERT, YA. L. *J. Exp. Theor. Phys., USSR*, **18** (*No.* 11) 995–1011 (1948) *In Russian.*—Results of the evaluation of experimental data on the ionospheric *F*-layer by a method allowing for its complete ionization. This permitted a more thorough analysis of the data with a view to explaining the anomalous behaviour of the F_2-layer. It is assumed that in the region of the F_2-layer the degree of ionization n_e in summer approaches saturation owing to the low densities of the neutral particles n. On this hypothesis the calculation of the distribution of density and temperature of the atmosphere is carried through for summer and winter and for altitudes of $\leqslant$400–500 km. For an altitude $z \sim 250$ km, $n \sim 10^7$. It is further thought that at 140–160 km altitude the temperature reaches a third minimum of 200°K. Values for the recombination coefficient α for the F_1- and F_2-layers are given, suggesting the existence of a daily and cyclic change of α in the F_2-layer. The data were then used for computing the value of the

"solar constant" in the range of 1 000–800 Å, and below, yielding a value of 1–1·5 erg/cm² sec. The author points out the difficulties encountered when comparing the experimental findings with the quantum-mechanical calculations of the cross-section of photo-ionization and of the recombination coefficient of atomic O. A.

551.510.535 : 551.51

2239. Critical survey of recent theoretical work on the ionosphere. PANDE, A. *Terr. Magn. Atmos. Elect.*, **52**, 375–96 (*Sept.*, 1947).—Deals with a large number of papers on upper atmospheric ionization, attempting in each case to assess the experimental data and reliability of conclusions drawn. The main subjects are Chapman's theory and its elaborations; the significance of group velocity in determining reflection; dissociation, recombination and attachment and their bearing on the anomalous F_2 region ionization; and the composition and temperature of the upper atmosphere. Many lines are shown to point to a high temperature in the F region and the relations of these to the seasonal and diurnal variations of density are discussed; it is shown that in some instances the data assume (indirectly) a certain temperature distribution and more care is needed in selecting pure experimental observations. F. T. F.

551.510.535 : 621.396.812 : 621.396.11

2240. Polar radio disturbances during magnetic bays. WELLS, H. W. *Terr. Magn. Atmos. Elect.*, **52**, 315–20 (*Sept.*, 1947).—A comparison of ionospheric and magnetic records at College, Alaska, shows that marked increases in ionospheric absorption, producing partial to complete radio black-outs, occur during magnetic bays. The period of the absorption is limited to the duration of the magnetic bay. Particle bombardment is suggested as the cause of polar region radio black-outs and sporadic E-ionization. The observations indicate that these absorption effects occur simultaneously over wide areas of $\lesssim$ 500 miles diameter. W. J. G. B.

551.510.535 : 621.396.812.3 : 621.396.11

2241. Periodic or rhythmic variation of the intensity of short wave radio signals. BANERJEE, S. S. AND SINGH, R. N. *Indian J. Phys.*, **22**, 413–22 (*Sept.*, 1948).—The results of study of periodic or rhythmic types of fading of radio signals which are generally observed during the sunrise and sunset hours. It has been shown by measurement of the angles of arrival of the downcoming waves that such fading may occur due to interference caused by two waves reflected either from one or two different layers of the ionosphere containing the required amount of electronic density, when one or both the layers have slow vertical movement, presumably due to rapid change of electronic density during the transition periods of ionization of the layers. It has been further shown that the development of slow periodic fading occurs due to the approach of m.u.f's between the transmitting and receiving stations, and on such occasions the interference is caused by magneto-ionic components of reflected waves as suggested by Appleton and Beynon. The interference phenomena have been verified by recording the periodic fading of short-wave signals transmitted from Delhi on 16 to 41 m bands at various hours of the day during different months. A.

551.510.535.08

2242. Sweep frequency ionosphere equipment. SULZER, P. G. *J. Appl. Phys.*, **20**, 187–96 (*Feb.*, 1949).—A new sweep frequency ionosphere sounding equipment is described. The equipment records ionosphere virtual height as a function of frequency over the range 1–25 Mc/s. Special features of the device are high power output, good receiver sensitivity, and anti-jamming circuits. A.

551.510.535 : 621.396.1 : 538.566.3

Critical frequency near $\tau = 1$. *See Abstr.* 2029

551.513 : 551.590.2 : 550.384.4

2243. Terrestrial influences in the lunar and solar tidal motions of the air. WULF, O. R. AND NICHOLSON, S. B. *Terr. Magn. Atmos. Elect.*, **52**, 175–82 (*June*, 1947).—It is held that the observed asymmetric phase-distribution with latitude of the lunar atmospheric tide is accounted for by the varying resistance to tidal airflow offered by the different surface features of the earth. This view is strengthened by the agreement of the annual phase change of magnetic diurnal-variation, resulting from solar tidal effects, with the annual phase-variation of the lunar tide. This suggests a common origin of the disturbing influence in the hemispherically asymmetric resistance to airflow presented by the terrestrial surface. D. R. B.

551.513 : 551.590.22 : 551.510.535

2244. Lunar variations in the principal ionospheric regions. MARTYN, D. F. *Nature, Lond.*, **163**, 34–6 (*Jan.* 1, 1949).—An analysis of semi-diurnal lunar height variations in the principal ionospheric layers has been made for a number of stations. It is found that for region E the phase of the lunar height variation is substantially in opposition at high and low latitudes. For regions F_1 and F_2 there appears to be no consistent phase change with latitude. These results indicate that in the case of region E the lunar oscillations are not of a simple tidal nature but are controlled mainly by electrodynamical forces. It is suggested that in a region of weak air tides the phase of the variations in regions F_1 and F_2 are controlled by the polarization field of region E. It is further concluded that the main seat of the lunar magnetic variations is below region E and that the integrated currents flowing in the regions from E to F are in anti-phase to those required to produce the lunar magnetic variations. W. J. G. B.

551.515.4

2245. The physics of thunderstorms. HORTON, R. E. *Trans. Amer. Geophys. Un.*, **29**, 810–44 (*Dec.*, 1948).—The physics of a thunderstorm is studied from the viewpoint of hydromechanics rather than thermodynamics, although the latter processes have not been entirely disregarded. The basic type of thunderstorm considered is the case in which the flow phenomena are similar to those existing in connection with two reservoirs with different pressures. The treatment of the various processes involved in a thunderstorm is mainly quantitative. Equations are developed based on the laws of continuity and fluid flow, from which the dimensions and characteristics of a thunderstorm can be determined. Questions

involving the limitation of rainfall splash, maximum limiting rain intensity of the thunderstorm, and the derivation of the characteristics of a thunderstorm, based on study of the rainfall pattern, are considered. The various hydrological factors involved in a thunderstorm, such as condensation, evaporation, expansion, and lift are discussed. A.

551.52

2246. On the temperature of the terrestrial atmosphere around 100 km. NICOLET, M. *Inst. Roy. Met. Belge Misc.* (*No.* 10) 11–17 (1942) *In French.*—Intensity distributions within the first negative bands of N_2 in auroral spectra indicate a temp. of between 250° and 265°K in the auroral region (90–140 km) during the northern winter. This value is ~40°K below that deduced for the sunlit atmosphere in lower latitudes at a similar altitude, as found from ionospheric data. Some uncertainty attaches to the latter deduction on account of lack of information on the composition of the high atmosphere. D. R. B.

551.55 : 551.513

2247. The circulation of the upper troposphere and lower stratosphere. ROSSBY, C. G. AND WILLET, H. C. *Science*, **108**, 643–52 (*Dec.* 10, 1948).—The authors consider that none of the models of the general circulation of the atmosphere hitherto proposed explain adequately the observed facts. Consequently a new scheme is suggested based on observations obtained mainly along the 80th meridian W. It falls under 3 heads: (1) some features of the seasonal mean state of the general circulation in the N hemisphere, particularly in the vicinity of the tropopause; (2) the character of the principal irregular variations of the circulations; (3) a tentative explanation of the normal pattern of the general circulation and its irregular variations. Under (1) it is shown that the outstanding feature is the existence of a circumpolar cyclonic vortex with max. intensity just beneath the tropopause in middle latitudes, bounded, particularly on the equatorial side, by a very sharp decrease of wind. In consequence it has been termed a jet stream. Under (2) the irregular fluctuations of the circumpolar vortex with its jet stream are shown to be of a threefold character (*a*) a simple contraction or expansion, (*b*) a variation in the speed of the jet stream, (*c*) a variation of the wave pattern in the vortex. In the third section the classical models and their failure to explain the results of observations are referred to. Thereafter a method of attacking the problem developed previously by Rossby [*Bull. Amer. Met. Soc.*, **28**, 53–68 (1947)] is discussed at length. The paper is illustrated by numerous diagrams.

A. E. M. G.

551.577 : 532.69

2248. Raindrop size, shape, and falling speed. SPILHAUS, A. F. *J. Met.*, **5**, 108–10 (*June*, 1948).—A theoretical relation is given connecting the shape of a raindrop, its surface tension, and falling speed. An assumption is then introduced which allows the drag coefficient for any drop to be expressed in terms of its shape, regarded as intermediate between that of a flat plate and that of a sphere. A third equation expresses the equality of weight to air drag, and a fourth gives the radius of a spherical drop of equivalent volume in terms of raindrop dimensions. Numerical values are tabulated to show theoretical results relating to size, shape, and falling speed; and curves are shown comparing experimental and theoretical values. G. G.

551.59 : 551.510.535 : 550.38

2249. Differential-penetration theory. ECKERSLEY, T. L. *Terr. Magn. Atmos. Elect.*, **52**, 305–14 (*Sept.*, 1947).—Differential penetration of the earth's atmosphere by electrons and positive ions in an incoming neutral corpuscular stream is discussed together with the manner in which this might explain a number of major ionospheric phenomena (longitude-effect, geomagnetic control and magnetic storm effects).

W. J. G. B.

551.59 : 551.510.535 : 550.38

2250. Differential penetration and magnetic storms. ECKERSLEY, T. L. *Terr. Magn. Atmos. Elect.*, **52**, 433–40 (*Dec.*, 1947).—The idea of differential penetration [preceding Abstr.] is applied to explain the observed ionospheric effects on the occasions of two great magnetic storms. The marked decrease in region F_2 ionization density during a magnetic storm is explained in terms of a horizontal motion of the ionization under the combined actions of the earth's magnetic field and a vertical electric field set up as a result of the differential penetration of the electrons and positive ions in an incoming neutral stream of particles. W. J. G. B.

551.593 : 525.75 : 535.43

2251. Effect of dust and haze on the spectral distribution of zenith-scattered radiation. KARANDIKAR, R. V. *Proc. Indian Acad. Sci. A*, **28**, 46–53 (*Aug.*, 1948).—Spectrophotometric observations on zenith-scattered light at Simla and Delhi showed that the intensity ratio, I''/I', for the longer wavelengths against the zenith distance of the sun, Z, was much higher on hazy days. As Z decreased from 90° to 0°, $\log I''/I'$ first decreased rapidly, then after passing through a minimum at approximately 45° increased at lower angles and at angles below 20° the increase was rapid. This was contrary to calculations of primary molecular scattering, which predict steady decrease as Z decreases. The anomalous behaviour is attributed to scattering by large particles present in the atmosphere. W. R. A.

551.593 : 535.43

2252. The primary and secondary scattering of sunlight in a plane-stratified atmosphere of uniform composition. HAMMAD, A. *Astrophys. J.*, **108**, 338–46 (*Sept.*, 1948).—The scattering of a parallel beam of unpolarized radiation by a plane-stratified atmosphere of finite optical thickness is considered, taking into account the polarization by scattering. Expressions are given for the component light-intensities and the degree of polarization of the scattered radiation for primary and secondary scattering. [See Abstr. 3599 (1939)]. A.

551.593 : 535.43

2253. The primary and secondary scattering of sunlight in a plane-stratified atmosphere of uniform composition. Part IV. The approximate evaluation of secondary scattered light. HAMMAD, A. AND HASSANEIN, S. A. M. *Phil. Mag.*, **39**, 956–66 (*Dec.*, 1948).—Simple approx. expressions are given for the

secondary scattered light. These depend partly on previous work [Abstr. 3599 (1939)] and are simpler and more accurate than those of Silberstein [Abstr. 181 (1943)]. L. S. G.

551.594 : 537.221

Contact potential difference between water and ice. *See Abstr.* 1892

551.593.9 : 535.338

2254. The possible presence of the spectrum of molecular helium in the radiation from the night sky. HERMAN, R. *C.R. Acad. Sci., Paris*, **226**, 1712–14 (*May* 24, 1948) *In French.*—In spite of the numerous spectrograms of the night-sky light now available many bands in the u.v. and visual regions remain unidentified. Trustworthy identifications are confined principally to forbidden atomic or molecular transitions. Analysis of laboratory "after-glow" spectrum of He_2 suggests coincidences in the visual with intense $A \rightarrow X$ band system of N_2. The He_2 bands, if present in the n.s., will be accompanied by continuum between 600 Å and 1 100 Å. The latter can ionize O and N in the upper atmosphere. D. R. B.

551.593.9 : 551.594.5

2255. The spectra of the night sky and of the aurorae. SWINGS, P. *Publ. Astr. Soc. Pacif.*, **60**, 18–26 (*Feb.*, 1948).—A discussion of the large amount of material now available on night-sky, auroral and twilight emission spectra suggests lines for future work. The importance is stressed of making detailed systematic photoelectric measures of monochromatic auroral intensities and their short-period fluctuations, with simultaneous height determinations. Present interpretations of auroral and night-sky spectra are still unsatisfactory, especially the latter. To account for twilight and dawn enhancements of the red [OI] emission, both well observed, no adequate theory exists. The three geophysical problems discussed appear closely related to those of cometary physics, stellar shells and interstellar clouds. D. R. B.

551.594.6 : 551.510.5 : 621.396.11

2256. Low-level atmospheric ducts. MCPETRIE, J. S. AND STARNECKI, B. Letter in *Nature, Lond.*, **162**, 818 (*Nov.* 20, 1948).—Radio field-strength measurements over a 60-mile oversea path, $\lambda = 9$ cm, show correlation with the difference between air and sea temperatures, particularly when this difference is large. Lower values of the field-strength are correlated with conditions in which the air temperature $<$ that of the sea. An explanation in terms of atmospheric ducts (20–50 ft above sea-level for the lower field-strength observations and 80–120 ft for the higher field-strength values) is suggested. W. J. G. B.

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591.18

2257. The temperature variation of narcosis induced in frogs by direct current (galvanonarcosis). WERNER, G. AND HOBBIGER, F. *Experientia*, **4** (*No.* 10) 405–6 (1948) *In German.*—The threshold dose was measured between 5° and 30°C, and found to be maximum at 20°. The recovery time was constant from 5 to 15°C (2·5 min.), and increased with temperature from 15° to 30°C (11·0 min.). From the results it is concluded that the passage of current results in the reversible disturbance of certain surface molecular arrangements. E. E. C.

591.185.63 : 525.37 : 531.114

2258. A preliminary study of a physical basis of bird navigation. SCHUMACHER, W. C. *J. Appl. Phys.*, **20**, 123 (*Jan.*, 1949).—Suggests that the movements of the bird's wings in the earth's field may produce alternating voltages more easily detectable than the minute direct voltages previously discussed. [See Abstr. 1132, 2634, 3556 (1948)].

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612.014.42 : 631.27 : 621.319

2259. The physiological effect of the electric fence. WINKELMAN, W. *Electro-techniek*, **26**, 423–9 (*Dec.* 16, 1948) *In Dutch.*—Various methods of energizing electric fences are briefly described. The reaction of the human body to the passage of an electric current depends on: (1) the path of the current through the body, dangerous when a large percentage of the current passes through heart or nerve centres; (2) the strength of the current; the safety limit for continuous currents is the let-go current, and for intermittent currents the strength at which fibrillation of the heart occurs; (3) the duration of the current, relations being obtained between fibrillation current and time for periods between 0·03 and 3 sec; (4) the type of current; optimum nerve sensitivity occurs in the region of 50 c/s, few data are available of the effect of the wave form; (5) the physical and mental condition of the person. J. A. F.

612.014.421.7

2260. Electronic mapping of the activity of the heart and the brain. GOLDMAN, S., VIVIAN, W. E., CHIEN, C. K. AND BOWES, H. N. *Science*, **108**, 720–3 (*Dec.* 24, 1948).—An extension of the electrocardiograph and electro-encephalograph is described, whereby a two-dimension picture or "area display" of the potentials developed by the heart or brain can be obtained, somewhat similar to the PPI presentation in radar. Motion pictures can be taken of the area displays and subsequently projected at a suitable speed to show the cyclic changes of the potential distribution. Originally a pick-up tube with electrodes located at 16 individual grids was used, and the potential on an individual grid regulated the current reaching the anode when the beam was passing through it; later an electronic circuit commutator was used. E. E. C.

612.014.481.08 : 539.16.08 : 621.386.86

2261. Instrumentation in the field of health physics. MORGAN, K. Z. *Proc. Inst. Radio Engrs*, **37**, 74–82

(*Jan.*, 1949).—Instruments for personnel protection from neutron, α-, β-, γ- and X-radiation exposure are described. Many new developments have been made, and photographs and brief descriptions of instruments are given. A.

612.863.6

2262. A theory of the Stiles–Crawford effect. TORALDO DI FRANCIA, G. Letter in *Nuovo Cim.*, **5**, 589–90 (*Dec.*, 1948) *In Italian.*—The fact that the intensity of a luminous source appears to decrease as the angle of incidence on the retina increases, is explained by assuming that the propagation of light in the retineal cones occur as in a dielectric guide. L. P.

614.8 : 539.185 : 539.16.08

Tolerance flux of thermal neutrons. *See Abstr.* 2133

614.898 : 539.16.08

Measurement of alpha-radioactive dust in atmosphere. *See Abstr.* 2061

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669.018 : 539.215 : 539.264

X-ray diffraction effects in patterns of aged alloys. *See Abstr.* 2147

PHOTOGRAPHY 77

77.023.4

2263. Analysis of the particle size distribution of the grains producing a photographic image. LOVELAND, R. P., MENIHAN, H. M. AND TRIVELLI, A. P. H. *J. Franklin Inst.*, **246**, 459–82 (*Dec.*, 1948).—The number of Ag-halide grains per sq. cm. of a commercial (multilayer) emulsion, and also their size distribution, were determined experimentally. A similar investigation was made of the halide grains unaffected during exposure and development by measurements on a developed, and unfixed, sensitometric step-wedge. Concentration, and size distribution of developed grains, were obtained by subtracting the measures for unaffected grains from those for the unexposed emulsion. The ratio of the number of grains, N_d, to the optical density, D, remained essentially constant and equal numerically to 4×10^8 up to a four-fold increase of development time. Average grain-size bore a linear relation to optical density. At max. density, the size distribution of undeveloped grains followed a simple negative exp. form with the smallest grains predominant. About 32% of grains remained undeveloped at max. density for normal exposures; in some cases it was possible to increase density still further by prolonging the exposure. D. R. B.

771.53 : 666.1/.2

2264. Photosensitive glass. RIESS, K., BOSCH, W. C. AND REBOUL, T. T. *Amer. J. Phys.*, **16**, 399–403 (*Oct.*, 1948).—Experiments with the new Corning light-sensitive glass are described. The recommended development temperature of 630°C was found too high and 565°C was found more suitable. Transmission curves of the unexposed and exposed and developed glass show almost even absorption for all wavelengths, but bluish and red discolourations occur which are separated in depth. In agreement with the transmission curve, the spectral sensitivity is confined to a very narrow peak at 320 mμ. Curves of transmission against time of development, and of density against log. exposure, show that the density range is limited, the maximum density not exceeding 0·25 over the useful part of the curve. The characteristic curve has a very long plateau where the density rises very gradually with exposure and a reversal region, where density decreases with prolonged over-exposure. W. F. B.

778.3 : 523.85

Photographic problems in nebular research. *See Abstr.* 1660

778.3 : 539.16

Recording of charged particles of minimum ionizing power. *See Abstr.* 2058

778.3 : 539.16.08

The distribution of radioactive elements in rocks by the photographic method. *See Abstr.* 2064

778.3 : 539.166 : 539.17

Nuclear emulsions containing D_2O. *See Abstr.* 2105

778.33 : 620.179.15

2265. Influence of field size on contrast and exposure in industrial radiography. TROUT, E. D. AND PACE, A. L. *Non-Destr. Test.*, **6**, 19–21 (*Spring*, 1948).—An investigation of the effect of scattering on the technique used in the radiography of steel plates $\frac{1}{4}$–$1\frac{1}{4}$ in thick. Back scatter and forward scattering measurements were made with a 25 r Victoreen thimble ionization chamber at 140, 200 and 250 kVp with field sizes ranging from 5×7 in to 14×17 in. Tables and graphs are given tabulating the correction in exposure for field size and of the effect on radiographic sensitivity. T. A. C.

778.33 : 621.386.832 : 620.179.15

2266. Low-voltage industrial radiography with fluorescent screens. HAY, R. L. *Non-Destr. Test.*, **6**, 29–32 (*Spring*, 1948).—Experiments were carried out with slow fine grained industrial X-ray film, primarily designed for direct exposure or with metallic screens and not recommended or manufactured for use exclusively with fluorescent material, which has been used with $CaWO_4$ screens. Radiographs taken at 120 kV of a steel step tablet of thickness from $\frac{1}{2}$ in

to 1 in. in $\frac{1}{16}$ in steps show that the contrast can be increased and the exposure reduced to $\frac{1}{3}$ by the use of the $CaWO_4$ screens. The technique has been applied to radiographs of welds in $\frac{1}{2}$ in steel. T. A. C.

778.37 : 535.312.3

2267. Residual defocusing and extent of useful image field when compensating optically by means of plane rotating mirrors. NAGEL, M. *Optik*, **3** (*Nos* 5–6) 541–54 (1948) *In German.*—So-called optical compensation by means of oscillating or rotating mirrors is often used (to correct for relative movement of object or image); but is complete only for a limited portion of the image field. General formulae are derived for the residual defocusing resulting from compensation by means of plane rotating mirrors. Equations are then developed for special cases, viz. for equal defocusing at centre and periphery of image, and for minimum integral of defocusing. Finally, the extension of the usable image field is calculated for a given defocusing at the centre and a given permissible defocusing at the boundary. It is established that the customary adjustment—speeds of film and image equal at the optical axis—is not the most favourable. D. L.

778.37 : 628.9.033

2268. High-speed motion pictures with synchronized multiflash lighting. ANDERSON, R. A. AND WHELAN, W. T. *J. Soc. Mot. Pict. Engrs*, **50**, 199–207 (*March*, 1948).—Equipment to synchronize a high-intensity flashlamp with a high-speed motion picture camera has been designed and built. The camera was a 16 mm, rotating-prism type and synchronization was accomplished by a brush-type contactor built into the camera. The electrical signal from the contactor was sent through a pulse-forming circuit to a trigger tube in the flashlamp circuit. The film speed was 1 800 frames/sec and the duration of each flash was $\sim 1\ \mu$sec. Resolving-power tests made by photographing a 1-foot disc revolving at 1 500 r.p.m. showed the marked superiority of flash-lighting over continuous light at these speeds. The resolving power measured for a rapidly moving object was doubled by the use of multiflash lighting, and, even in the case of a stationary object, a 25% increase was obtained. A.